JPRS L/9652

8 April 1981

Japan Report

(FOUO 21/81)

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300100015-1

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POLITICAL AND SOCIOLOGICAL

EXPERTS DISCUSS NATIONAL SECURITY REQUIREMENTS, OPTIONS

Tokyo NIHON KEIZAI SHIMBUN in Japanese 1 Jan 81 pp 32-33

[Symposium Report" "Comprehensive National Security and Japan's Option"; Participants: Jun Eto, professor at Tokyo Institute of Technology; Kan Moroi, president of Chichibu Cement Co., Ltd.; Nobuhiko Ushiba, former roving ambassador]

[Text] "Afghanistan," "Iran-Iraq War," "Poland,"--while events that indicate changes in the current trends of the international situation are taking place, the turbulent 1980's have entered their second year. The government has established the "Comprehensive National Security Cabinet Council," and there is an increasing movement to understand, from many angles, the national security problem. On the increasingly important issue of "Japan's national security," Jun Eto, a professor at Tokyo Institute of Technology, Kan Moroi, president of Chichibu Cement Co., Ltd., and Nobuhiko Ushiba, former roving ambassador, were asked to participate in a symposium. Also, Ganri Yamashita, former director general of the Defense Agency, was asked for his comments from a political standpoint. (Moderators were Tetsuo Ota, chief of the economics department of the Tokyo main office, and Makoto Fukagawa, chief of the political department.)

Obtain a Consensus

Reporter: The concept of "national security" should probably have been considered to be inherently comprehensive in nature, but heretofore it was interpreted with great emphasis on the military aspects. I believe that it was only 2 or 3 years ago that the argument was made that it was more appropriate to apply the term "comprehensive national security," and to look at the problem systematically. What is your assessment of such changes? First of all, I would like to ask what the problem areas would be, if any.

Ushiba: I agree with the viewpoint that national security should be comprehensive in scope, but I believe that its core would be the present defense power. In Japan's case, the term "comprehensive" began to be used intensively because of circumstances which make it difficult, from a defense standpoint, to express matters freely or openly. There are limitations in defense, no matter how much effort is put in, and the excuse that there was a need to share international responsibilities and tasks was used extensively. I also think that the term "comprehensive national security" is being used frequently in Japan because if defense power were to be publicly emphasized, there would be real problems in trying to accomplish anything and develop a national consensus.

Of course, comprehensive national security is fine, but Japan is weakest in its defense capability. Also, Japan can never become self-sufficient in food or energy supplies. Therefore, if you were to ask if Japan's national security would increase greatly by using the term "comprehensive national security," I would say not necessarily so. For the above reasons, I believe that the concept of comprehensive national security has its limitations.

Moroi: The Japanese people have generally given up hope for a high growth rate and, although dissatisfied, have resigned themselves to a low growth rate. But they are beginning to have doubts, when they look into the future, as to whether the present "so-so situation" can be maintained.

Discussion of comprehensive national security became widespread because the United States is no longer absolutely superior to the USSR in military balance, and Japan has trouble procuring natural resources, energy sources, and foodstuffs whenever disturbances arise in various parts of the world.

I believe that problem areas should be pointed out, but finding concrete solutions is extremely difficult. Under the present circumstances, it is hard to predict whether a national consensus can be tightly firmed up on the various specific proposals for solutions.

Eto: The fact that the government has begun to take the lead in thinking about national security shows an earnestness, but I think the government showed it was not serious when it attached the modifier "comprehensive." National security is always regarded as being comprehensive in scope. If national security cannot be discussed without the flossy concealment of the term "comprehensive," then the government is not earnest. Therefore I feel that the government has begun to get serious, but that it still is not truly earnest.

I say that it is not earnest because, as you two have indicated, the problem of national security must be considered with the defense problem as the nucleus. The procurement of natural resources might be stabilized, but if maritime transportation routes were cut off, there would be terrible consequences. How to map out the techniques of survival is the problem we face in national security.

Survival might mean the possibility of facing starvation or [experiencing the inconvenience of not being able to make things], but ultimately, national security must be prepared for the worst situation in order to prevent our lives and property from being directly threatened. If not, security "exists only in form but not in spirit," and therefore the military problem must be taken up. At least, it must be treated as the central issue, and other related problems, which are to be expected, must also be fully considered. If in the future the concept of comprehensive national security is actually to be pursued, then its substance must be carried out accordingly.

Reporter: How should the substance be carried out concretely?

Eto: I believe that there are too many items which are discussed only among experts. It is said that if Japan is attacked from somewhere, the United States will come to its aid. However, no one has taken the trouble to think through com-

prehensively how many weeks Japan would have to hold out, and to explain it simply to everyone. There has been no explanation as to the logistics (transportation and supply system) of how many thousands or tens of thousands of American troops would take what route and what actions to come to the rescue. In fact, even the Americans probably have no such plans.

The purchase by the Self-Defense Forces (SDF) of new aircraft such as C-130's and F-15's might adjust the trade imbalance between Japan and the United States, but as to how and when they are to be used, the only explanations given have been in the Diet interpellations. No one has explicitly stated whether or not such explanations are forbidden. What is the actual situation? Perhaps the situation might be terrifying; if so, it should be noted as such. Otherwise, I think we cannot make any headway.

Ushiba: There is a feeling that Japan would draw worldwide sympathy if it preached comprehensive national security. I also believe that there are aggressive views that if Japan increased its defensive capability, it would be easier for Japan to obtain oil, but this is not the actual case. Since comprehensive national security will further increase its responsibilities, Japan's position will not get better simply because Japan advocates it. There is one factor which must not be overlooked. That is, even if Japan increases its defense power, no other country will give special consideration to Japan's oil and food supplies. I think that there is a line of thought that Japan can shrewdly evade its responsibilities [by preaching comprehensive national security]. Such thinking is the frivolous aspect that has been pointed out earlier.

Moroi: A segment of financial circles is voicing adventurous views such as starting a draft system, installing nuclear weapons, increasing military armament at a spectacular pace, dispatching troops overseas, etc. However, the general view is to maintain the status quo. I feel that the prevailing viewpoint is that it would be sufficient to maintain, by spending about 1 percent of the national income, the power to repel small-scale, surprise invasions and to cope with internal rebellions. Underlying this viewpoint are doubts that the United States would really defend Japan, or whether it would succeed even if it tried. Since there is no definite answer, I think some believe that half-hearted efforts would not have much effect and have actually given up hope.

Eto: I think I understand the situation that Mr Moroi just described. However, I believe that some claim they are satisfied with the present situation because they do not truly understand it. It might be presumptuous for me to say this, but I think that it behooves financial circles to do more study and research on the existing situation. Some have advocated nuclear armament. When Japan-U.S. relations are considered, such advocacy of nuclear armament means bringing those relations to their ultimate end. Have the advocators considered this development when voicing their views?

I believe that the maintenance and development of Japan-U.S. relations constitute the basic conditions for the survival and prosperity of Japan. To suggest an alternative such as nuclear armament is too radical a turnabout. I do feel that the doubt as to whether the United States would defend Japan would only become stronger in the future. Therefore, the extent of Japan's exposure to international conflicts

would be heightened at an accelerated pace hereafter. On such occasions, consideration must be given to methods of cooperation for maintaining Japan-U.S. relations and for developing it to cope with new situations. That should be the starting point of the basic thinking on this matter.

Strengthen Japan-U.S. Relations

Reporter: In the 1980's, particularly with the birth of the Reagan administration, there might be a realighment of international security alliances, with the United States as the nucleus. If Japan-U.S. relations are to be restructured, what direction should this take?

Ushiba: Basically, the Japan-U.S. Security Treaty is a deterrent factor and was not drafted on the assumption of conducting warfare. It is true that the deterrent power is weakening, but the issue from the beginning has not been one of whether the United States would or would not defend Japan. The problem facing the Japan-U.S. Security Treaty is whether or not the deterrent power would be effective. If deterrent power were not the essence of the Security Treaty, why has the SDF continued, right up until the present, a readiness state in which all the ammunition would be used up in a single day's battle? This probably indicates a belief that war would not occur. It was believed that the deterrent power was effective. Thus, to raise the question now as to whether or not the United States would protect Japan is a ridiculous mistake. The problem is what to do about the weakening deterrent power.

A revision of the Security Treaty is politically impossible at this time. I think that such discussions (Security Treaty revisions) might arise in the United States. However, such talks will not develop into a main trend. I do not think that there would be many on the Japanese side who would favor such a move. Particularly at this time, when there has been a change of political regime in the United States, Japan must be careful not to make any hasty proposals, since there might be disastrous results.

Any realignment of alliances is a very serious matter. However, the United States is now concerned mainly with Europe and does not think Japan would pose any problems. Because of this U.S. attitude toward Japan, however, it would be erroneous to immediately conclude that the United States would withdraw troops from the Pacific area or that it has no interest in Japan. Personally, I think that Japan is overexposed in the United States. I think that there has been too much talk about Japan. The movie "Shogun," which was shown recently, drew fantastic interest. It is said that because of the movie, the sale of Japanese sake increased tremendously there. The reason is that in the movie, everyone was drinking sake.... (laughter) At any rate, it would be better for Japan to be left alone.

What Japan should do now is to tell the United States "what it wants the United States to do" and "what Japan can do." If Japan simply waits, there is a possibility that the [U.S.] demands will gradually escalate--I think this is the present situation. If there were to be realignment of the alliance, what could Japan request from the United States? Ultimately, Japan could probably ask only for meaningful prior consultation before the United States made any decision. Although it is said that the United States has weakened, it is still the United States which has the

power and the decisive lever. Since Japan has been supported by that till now, it has the one request for the United States "to hold fast to the lever."

However, unless the "perceptions" of both countries get closer, there will be no communication. It could be said that relations between Europe and the United States are not good at present, but this is because the difference in their mutual strengths has narrowed, and since they are tackling the issue of dividing the tasks, many problems are arising. Japan has not yet arrived at that stage, and so what it says has no significance. One step before that, I think, it is important to get a closer look at the "perception" problem concerning basic concepts. I think that is the most essential action for strengthening the alliance.

Eto: Starting the summer of the year before last, I stayed for nearly a year in Washington, D.C., and during that period various problems arose such as the Iranian conflict, the Soviet invasion of Afghanistan, etc. Looking at things from Washington, I believe that the perception of the Japanese has begun to change somewhat from before. As an issue, national security has remained in a negative sense throughout the postwar period in Japan, with the flossy concealment of the term "comprehensive national security." The fact that a discussion has arisen as to how Japan should internationalize is in itself an indication that Japan is not fully participating in international matters. In economic activities, Japan is not only "fully" participating but is 120 or even 150 percent active, and the role and weight of Japan in the international economy are commonly perceived by the people to be for their good.

However, when it comes to international politics, Japan's position and role are not fully understood by the government, not to mention the man in the street. This strange insensitivity cannot be blamed on the Japanese alone. This is partly the fault of the postwar treatment by Allied countries. It might be the result of many years of interaction. Therefore, the fundamental makeup of the country might have to be realigned somewhat to conform to the present conditions.

In other words, it is extremely doubtful that the conscious awareness of the Japanese people can be changed without touching on this problem when the issue of the constitution is taken up. I believe that the Japanese awareness will not change unless the Diet clearly recognizes that the SDF, which is labeled an administrative agency, is recognized as a truly military organization.

In one's curriculum vitae in the United States, there is always a column called military record. Would the outlook toward the world of a person who feels it only natural to fill in this column be the same as our world views? When I filled in the curriculum vitae upon employment by Princeton University, I first realized that there was this difference between my awareness of the world and the attitude toward the world of my American friends.

The Japanese people live under the assumption that they are the same human beings as those of other countries, but this is not true. In a sense, they are Martians living on earth, and the question is when the Martians can become earthlings or whether they believe they can survive forever as Martians. I believe that the abandoned hope mentioned by Mr Moroi and the perception difference pointed out by Mr Ushiba are the result of this Martian personality.

Moroi: A certain section chief, who is one of the elites of a great enterprise and not quite 40 years old, asked me recently, "Really, is a country worth defending with your life?" Of course I think he was speaking paradoxically, but I was shocked to be asked such a question. Because the Japanese suffered so much in the last war, many in the populace oppose war at all costs, even if they have to surrender. Therefore, it is very difficult to make the people understand and to take the lead in formulating a consensus, even with regard to the constitutional revisions.

It is inconceivable that Japan did not have a world strategy after the last war. For example, reliance on the Security Treaty is part of a world strategy. However, that was not clear-cut in any sense and was not approved by national consensus as such. Now is the time for the entire nation to think about it so as to arrive at a national consensus and to make it apparent as being Japan's world strategy. Unless this is done, Japan's action would not be understood by the outside world and Japan might become isolated in the international environment. I believe that it is essential at this time to formulate a distinct world strategy founded on national consensus.

Consider Strategic Aid

Reporter: There are discussions concerning the limitation of defense expenditures to within 1 percent of the GNP (gross national product)....

Eto: We are taken in too much by such expressions. If it becomes obvious that the 1 percent figure must be exceeded to get things done properly, then it should be exceeded. Therefore, I think that before discussing the 1 percent figure, one must decide what is to be done. To accomplish that, various necessary steps must be taken. If there are legal obstructions, then they should be corrected. Since Japan is a sovereign nation, it can do that much, but the rest depends on U.S. deterrent power. Before the Reagan administration's world strategy is firmed up, Japan should propose that it will do what is necessary, even if indirectly, to strengthen the deterrent power.

Moroi: Since I am not an expert, there are things I do not understand, but I believe that there is a form of consensus on the 1 percent figure is in itself significant. Therefore, I do not think we should destroy it. Although only 1 percent, rather than a monetary sum, the important factor is how the money is spent. Until now, the parents called the United States were very strong, so Japan was absolutely safe if it stayed with its parents. However, if the parents weaken, is it enough if the children only take actions which please the parents? Or should the children really prop up the parents? From the standpoint of deterrent power, isn't some action associated with nuclear weapons necessary to make the deterrent power effective?

Ushiba: What Mr Moroi has just said is true, but in the natural course of events, the United States keeps making demands on Japan. Presently, the problem is how to meet those demands. The next problem is how Japan can assist the United States with regard to deterrent power, and there is no need now for us to worry about it. To want to worry prematurely is a tendency of the Japanese intelligentsia. (laughter) For example, there is presently no problem of a food shortage, but because there is talk of a possible food crisis, reports such as that made by the Agricultural Admin-

istration Deliberation Council in late October 1980 begin to appear. Only essential items would be imported, and the rest would be grown domestically--what would happen if that is carried out?

As for the comment on world strategy, I am in agreement, but at present Japan must be most concerned with what is protecting Japan. That is international law as well as international order. A clear-cut statement that the Japanese absolutely oppose any country which disregards them and uses force contributes greatly to national security. For example, take the automobile problem. As for the problem faced by a country whose own industries are being hurt by imports of Japanese automobiles, there is a safeguard (the emergency import restriction clause) written into Article 19 of GATT (General Agreement on Tariffs and Trade). Wasn't that agreed upon by everyone? Without trying to apply the safeguard, Europe is asking Japan to voluntarily restrict exports. Toward such actions, Japan should have confidence that it can resist on the basis of international law. In that sense, I think international rules should be a part of Japan's world strategy. That point has been forgotten by all.

Reporter: During the postwar period, as a rule, Japan's exports have always grown whenever Japan has participated in economic cooperation. Probably, from now on, a slightly altered form of economic cooperation is necessary in giving aid to strategic areas.

Ushiba: The first point is to make it "untied" (no strings attached). Japan is the world's leading country in giving "untied," aid and it should be continued since it appeals to the world. There are many now in Japan who complain about "untied" aid, but this is good publicity for Japan. The other point is to consider giving strategic assistance. This will contribute to the U.S. deterrent power. In essence, it would build up the power of countries receiving aid to resist.

Moroi: The defense buildup should be confined to the 1 percent limit, on which there is consensus, and more effort should be put into economic cooperation and aid. The view that national security should be strengthened through those means is becoming stronger in financial circles. Mr Ushiba criticized the shortcomings of the intelligentsia, but I believe that in trying to persuade the Japanese masses, there is no other means to infiltrate their minds except to repeat arguments and explanations in very lucid terms. It is easy to formulate a consensus on the position that, since Japan is sure to receive a shock whenever a disturbance occurs somewhere in the world, Japan should or must take necessary actions, even with sacrifices, to try to prevent such distrubances or changes from happening. Concretely speaking, I feel that, partly for the reason just stated, the emphasis of the financial world will shift toward that direction.

Eto: In trying to gain an insight into the national psychology, is it correct to assume that because something had been so, it will continue to be the same? I do not think that this will be the case in the 1980's. I think that it is a period when the national psychology will change considerably and run counter to the experience patterns of the intelligentsia, political circles, the economic world, or journalists. To gain an accurate insight, it will be necessary to raise questions continuously in explicit terms under directed guidance.

The viewpoint that defense spending should be limited to 1 percent and that the emphasis should be shifted to economic aid seems to be a healthy one. However, to give a specific example, such as the report by the Agricultural Administration Deliberation Council, even if it is carried out, Japan's agricultural productivity would never equal that of the United States. If that is the case, it will be necessary to import cheap, good farm products in quantity for the people's benefit. Who will secure the transportation routes? Japan cannot independently protect the route. If a situation should come about whereby grain products could not be supplied normally, a serious problem would arise in Japanese-U.S. economic relations. Therefore, it would become necessary to ask the U.S. Pacific Fleet to protect the route and assure a steady supply. Discussions should be so linked (related).

It is odd that when the magic wand of comprehensive national security is waved, arguments arise that everything ought to be done independently. With regard to oil reserves, where would the supply for over 100 days be stored? There is talk that the oil would be stored in tankers floating in waters off Ogasawara Island, but what would happen if someone attacked? How to prevent such attacks is a question that inevitably comes up with regard to oil storage. In order to do that, how much would it cost and where would the funds come from? That would show that the problem is being earnestly discussed. It seems that it is not being done.

The financial circles also claim that if there were an oil reserve of several tens of days, Japan would be that much safer. It would be excellent for there to be a discussion on how to store the oil so that there would be a stable supply, no matter who attacked, and what actions would be necessary to accomplish that. However, such discussions are not being conducted. Such talks are sensitive and draw various complaints, so they are avoided. This shows an insincere attitude.

Moroi: Japan is not storing oil in anticipation of attacks but to prepare for the eventuality that disturbances might occur in the oil-producing countries from which Japan imports and that the supply might be cut off for a while.

The thinking of financial circles is opposite to that of the view just expressed. There is no suggestion of self-supply. It is important to bring in energy sources (from outside), but by developing alternate sources of energy, such as nuclear power and coal, the rate of self-sufficiency could be raised. In that case, the fastest and most plentiful source is nuclear power generation, but it is unfortunate that the problem is left to the electric power companies, and although everyone understands, no one wants to be involved. The government, administrative staffs, and financial circles should all cope with the problem. This is an important item of national security.

Proposal

Reporter: I would like to hear your proposals concerning national security for the future.

Ushiba: As far as the defense problem is concerned, Japan should decide "what it can do and what it cannot do" and inform the United States as soon as possible. Since the Reagan administration will be preoccupied with many matters, it would be a mistake for Japan to think that it constantly occupies the focal point in U.S.

thinking. Before their (administration) is decided upon, Japan should present the proposal.

As for what is demanded of Japan, Defense Secretary Brown has already said it repeatedly. If that is revealed to the nation, the people will probably say, "Well, is that all?" To keep it hidden and to give the impression that the United States has made serious demands is not a wise move. Since there was a change in the U.S. political regime, the delay (on a final understanding between Japan and United States concerning defense outlays) was inevitable. Japan should immediately lay its cards on the table and inform the United States how much it will do. I think that this is the most important item concerning defense power. The other important item for Japan's national security is to closely observe international rules, regulations, and principles.

Eto: Mr Moroi used the simile of a parent-child relationship, but one should be aware that international relations cannot develop into such a relationship. I am not saying that Japanese-U.S. relations are cool. Relations are warm, but they are founded on harsh individual interests and nothing more. Therefore, a commitment and obligation to follow international rules and order are important.

When I think along these lines, I believe that the next item we should consider is nuclear energy. It is significant as an energy source and essential as a deterrent power. Japan has the unique experience of having been bombed by a nuclear weapon. Presently, although the U.S. deterrent power has weakened comparatively, it is still reliable. To put it bluntly, if there is such a thing as a U.S. nuclear umbrella, we should try to use it until it becomes obsolescent. That should be our fundamental position. Since the destructive power of nuclear weapons is so great, the chances are growing that it might not become the ultimate weapon. It is inconceivable that nuclear weapons would be used in future international conflicts. Rather, the possibility is stronger that complicated, normal warfare would be conducted. Then the question arises as to what would follow nuclear weapons.

For example, even in the United States, arguments are growing stronger that a strategic balance cannot be maintained with the USSR under the present conditions and that, in addition to nuclear weapons, laser-related weapons must be developed to augment U.S. power. If Japan can fully develop such items in the future, they might serve as a deterrent against attempts at a nuclear attack.

If Japan's highly sophisticated electronics technique can be utilized, some threatening indications from abroad can be detected quickly. Then if the entire world is informed about them, the security order established to observe international law can take the necessary action. This is not something which can be done in 2 or 3 years. However, before the end of the 1980's, if the industrial and financial circles would invest heavily to develop it, the government would lend assistance, and the nation would support it, then Japan's strategic position could be raised by leaps and bounds. While Japan might not surpass the United States or the USSR, it could become their equal--without using nuclear armament, which is considered a dirty weapon and a difficult choice morally. It is not a dream that it can exceed even nuclear power. To direct Japan's science and technology toward that end is the most essential task in Japan's national security. However, Japan should not develop such weaponry but develop the capability for it.

Somehow, I am most worried about the first 5 years of the 1980's because something might happen, but if Japan survives without being hurt, then our world image should have greatly changed by the end of the 1980's and we should have pride.

Moroi: I agree with what you have said, but I think that the most important factor is, after all, the vigor, pride, and morale of the people. To take the defense problem as an example, no matter how much is provided in the way of armaments, if the persons who use them have no spirit to fight, then the situation is hopeless. Furthermore, in the case of a small-scale invasion, even if the SDF put up a great battle, if the people behind the lines were to say that the country should surrender immediately, the SDF would lose the spirit to fight. The question is how to build up the vitality and self-respect of the people. In this day and age, even if the higher echelon dictates that you should do this or do that, or say that you are mistaken or a disgrace, nothing will happen unless the people truly believe in it. To do that, it is important to obtain a national consensus by putting forth a clear-cut world strategy or to propose a world strategy which can win their consent.

Another item, and this might be beside the point, but what exactly is the meaning of U.S.-Soviet confrontation? It is said to be a confrontation between democracy and socialism, but adjustments are being made respectively, and in 10 years they might become similar. Whether it be the U.S.-Soviet or the North-South confrontations, Japan should give serious consideration to the easing of the confrontations and the spreading of peace and stability around the world and the survival of mankind. Therefore I feel that in diplomacy, Japan should utter rather strong statements favoring the easing of confrontations.

[Interview format as published; apparent new speaker from this point on]

Improve the Quality of Defense Capability

The heightening of East-West tensions and Third World developments--particularly the conflict within the Arab bloc--in the turbulent 1980's continue to bring forth severe disturbances. After listening to the advice and views of Messrs Ushiba, Eto, and Moroi concerning the security problem, I feel, as a member of the political world, an increasingly heavier responsibility toward my duties.

When considering the subject of comprehensive national security, I think the most important element is, after all, the defense problem. The stable supply of energy sources, such as oil, and of other natural resources has a direct bearing on the very foundation upon which Japan stands. It is only natural to consider national security from an overall standpoint. However, I am worried that because the comprehensive nature of national security is overemphasized, the focus becomes blurred. I am concerned that because the Comprehensive National Security Cabinet Council has been established, the role of the National Defense Council [NDC] will become diluted. Of course, there is a need to improve the operations of the NDC, but as the organ with the expertise to deliberate upon Japan's role in the defense sphere, the NDC's functions must be kept intact.

Especially urgent as a defense task is the need to decide "what to do" and "what must be done," as Mr Eto pointed out. On looking back, I can say that the defense buildup since the First Defense Buildup Plan has been concerned only with outward appearances. Now is the time to develop a high-quality, balanced defense capability which will build up not only frontline armaments but also rear support strength. First of all, the transportation capability must be built up.

In this connection, a point that must be brought up is the ceiling of 1 percent of GNP imposed on defense outlays. Some claim that the 1 percent ceiling puts a brake on defense expenditures, which could increase limitlessly. Unjustified expansion of defense spending has to be avoided at all costs, but the 1 percent limit must not become fixed if there is something essential that has to be done for Japan's national security.

On the other hand, the weakening of the U.S. deterrent power has become the central point of national security discussions. I suggest that efforts be continued to strengthen mutual trust between Japan and the United States, without thinking or worrying about too many things. As a result of last November's Presidential and Congressional elections, it is possible that the U.S. side will present a number of viewpoints. Some Americans might propose that the Japan-U.S. Security Treaty be altered into a reciprocal arrangement. In view of the basis of the Japan-U.S. security setup, it is essential for Japan to improve and further strengthen existing bilateral relations.

As long as Japan and United States mutually protect their national interests and thereby solidify their relations, it is not conceivable that the U.S. side will make unreasonable demands. What is possible and what is necessary should be carried out by Japan for its own good, and if the request is too big or must be refused, then Japan to overreach itself to meet U.S. demands; in fact, to do so would detract from Japan's security.

While there is a lot of talk about the threat of the USSR, which is accelerating its military buildup, I think that from an overall standpoint the power of the United States has not weakened. We must be careful not to follow the example of USSR, which is rapidly increasing its armaments to cover up its domestic economic deficiencies. For Japan, it is urgent to avoid halfway discussions and to build up its defense capability independently. As far as the nuclear problem is concerned, the three nonuclear principles should be followed strictly, and nuclear armament must be absolutely prohibited through political power.

In order to cope with the harsh internal and external conditions, the formulation of a consensus, which Mr Moroi mentioned, is a big political task. In order to do that, the position in which Japan has been placed must be honestly and clearly explained. The approach should be a natural one, with an independent judgment of the situation and independent questioning and search for solutions to problems. An unnatural approach, forcing dogmatic answers like "this must be so" on the people, must be avoided. The time has arrived when evasion is not permitted, and as a politician I want to be farsighted, to express my position and opinions without deceit, and to find and present the best methods of solving those problems which are within the realm of possibility.

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CSO: 4105

ECONOMIC

DEFENSE INDUSTRY ASSUMES CAUTIOUS STAND, CONFIDENT IN MORE SPENDING

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 11

[Article by Yoichi Motohasi, NIHON KEIZAI SHIMBUN correspondent]

[Text] Talks on defense problems have been activated in Japan with the debut of the Reagan Administration in the United States and the resulting belief that the Americans will apply strong pressure on Tokyo to step up its defense efforts as a member of the free world.

At the New Year's meeting of the Japan Chamber of Commerce & Industry, for example, Chairman Shigeo Nagano openly wondered about the possibility of Japan's exporting weapons and parts to countries not likely to engage in overt international military actions. This announcement touched off wide-ranging repercussions in various circles.

Three basic principles

The defense industry itself, however, is rattled, rather than pleased, by this turn of events. The industry apparently feels that it should be left alone for the time being — at least until the days when a greater consensus on arms exports is formed among the Japanese public.

The Japanese Government currently prohibits weapons exports to: 1) Communist countries, 2) countries where weapons exports are prohibited under UN resolutions, and 3) countries currently engaged in or likely to engage in international military conflicts. This Government stand, in force since 1967, is what is usually referred to as the "three basic principles for weapons exports."

In 1976, moreover, then Prime Minister Takeo Miki declared that Japan should refrain from exporting arms even to countries not specified in the "three basic principles."

In order to export weapons, Japanese corporations are currently required to obtain the International Trade & Industry Minister's approval. MITI's stand on this problem is reportedly very stiff. Reports have it that, when a certain electric machinery company tried to sell its weapons export idea to MITI it was flatly turned down by an official in charge who declared that he seriously believed in the "three basic principles."

It is true that there is a strong underlying belief among Japanese weapons manufacturers that current strict restrictions on overseas weapons shipments should be relaxed.

"What developing countries are currently in real need of are weapons and foodstuffs," admits President Zenji Umeda of Kawasaki Heavy Industries, Ltd. "Japanese manufacturers should be allowed to accommodate such countries' needs as long as military equipment is for their self-defense."

Illegal exports

Many in the industry, however, are far from wholehearted in their call for relaxation in arms export regulations. "It is true that exports will immensely expand the market for the Japanese defense industry and will contribute to lowering production costs," states the Secretariat of the Defense Production Committee of Keidanren (the Federation of Economic Organizations). "We are not in a position to push for relaxation on export controls, however, if we consider our country's place in the international community..."

All those concerned in the industry do not hide their irritation at Hotta Hagane Co. of Osaka which made infamous headlines a while ago for its illegal gun barrel exports to the Republic of Korea. "The incident is too crude for us to make any form comment on," spits out Chairman Tomio Tanatsugu of the Japan Arms Industry Association (concurrently vice president of Toshiba Corp.).

"Hotta Hagane is not even a

member of our association," concurs another official of the Japan Arms Industry Association when faced with the International Trade & Industry Ministry's conclusion that the Osaka machinery exporter had actually committed an illegal action. "Legitimate" members of the arms industry appear disgusted at the peccadillo committed by an outsider.

'Overall security' policy

The defense industry has its own reasons for remaining cautious about the call for decontrol of arms exports. One is the fact that, even if arms exports are openly approved vis-a-vis countries not covered by the "three principle," not much benefit is expected to come out of it.

"The international situation, if anything, has become all the more tense today than the time when the three principles came into being," states Chairman Tanatsugu of the Japan Arms Industry Association. "Where in the world can we expect to make any significant exports? You would be nuts to believe that we can make enough exports to bring down production costs of made-in-Japan weapons."

Another reason is that the Japanese arms industry is not yet in a position to boldly blaze international markets for its products. Japanese manufacturers are believed to have fairly excellent technology in production of tanks and missiles. Are they, however, really prepared to fight it out in international markets with leading weapons manufacturers of Western countries? The answer apparently is no.

"We cannot equip our own country with enough defense weaponry," remarks Vice President Kosaku Inaba of Ishikawajima-Harima Heavy Industries. "How can we contribute to other countries' military efforts?"

The final direction of the nation's arms industry has to be charted, not by the industry itself, but by the government in the context of the nation's overall national security. It is all up to the government whether to approve arms exports, put the weapons industry on a true mass production system and make the Defense Agency accessible to low-priced arms or whether to use, as does France, weapons exports as an instrument for securing natural resources.

In the meantime, Director General Joji Omura of the Defense Agency proudly stated at the New Year's meeting of the members of the Japan Arms Industry Association, that, although the defense budget for fiscal 1981 failed to increase by the original target of 9.7 per cent, the budget content is something to be proud of.

'Enough work'

What Omura primarily meant by his statement is that the budgetary appropriations for combat and related weapons have been increased by as much as 17.7 per cent for the new fiscal year of 1981 over the preceding year. It is true that a considerable portion of such weapons, including C130 transport planes, will have to be imported. Weapons to be produced within the country, however, also are steadily increasing. The Japanese arms industry, in other words, can currently afford to sit tight without crying for decontrolling of arms exports; it has enough work to do for the time being.

"What we have to do above anything else," states Chairman Tanatsugu of the Japan Arms Industry Association, "is to plant our feet firmly on the ground and build our industrial and technological prowess." "The Japanese arms industry had better avoid the risk of getting burned," concurred Chairman Yoshihiro Inayama of Keidanren in a speech made at the Foreign Correspondents Club of Japan, implying that the present call for freer arms exports is the proverbial chestnuts in a burning fire.

The Japanese arms industry seems to believe that it has to be extra cautious at this crucial time in order not to deflect, by some careless moves, the nation's steadily growing mood for the necessity of reasonable strong defense and the government's willingness to bolster defense expenses. Such touchy problems as arms exports can best be left alone, according to many industry leaders.

CSO: 4120

ECONOMIC

DEVELOPMENTS IN INTERNATIONAL SMALL CAR WAR ANALYZED

Tokyo YOMIURI SHIMBUN in Japanese 31 Jan 81 p 3

[Text] Nissan Lands in Great Britain; High-Level Political Decision Involved

Nissan Motor Co Ltd's decision to independently construct an automobile plant in England has caused complex repercussions not only in England, which is suffering from unemployment and serious recession revolving around its automobile industry, but also the rest of the world, beginning with the European community [EC]. This is because the decision to venture independently for the first time by a Japanese automobile maker into Europe, with its deep-rooted "distrust of Japan," is bound to engulf the international small car war into a new state of affairs.

The reaction among members of Japan's automobile industry has been varied. "Nissan's decision is backed by high-level political resolution," some surmise, but on the other hand, cold remarks like, "Mr Nissan, are you serious about your decision?," are being heard. But this sort of cold reaction by the industry probably includes a feeling of envy at Nissan for its successively spectacular international enterprises.

The automobile industry has entered into international realignments in preparation for engaging in the international small car war. Within this arrangement, Japan's automobile industry, which has progressed one step ahead in the development and mass production technology of small cars, has an advantage compared with that of the lagging United States and European countries. This advantage has been the cause of friction with the automobile industries in the United States and Europe, resulting in a serious political problem; moreover, it has been a condition for the overseas production and international tie-ins demanded by Japan's manufacturers.

With this sort of background, a great accomplishment in improving relations between England and Japan can be expected through Nissan's plant construction in England. However, for England's automobile industry, which has fallen into the lowest state of depression since the war, a strong rival is being added to the number of competitors, and some have said: "It will not lead to any relaxation of tension in the British automobile industry. Instead tension will increase."

At the moment, the concern is focused on the reaction the British industry exhibits at the 2-day Japanese-British private automobile conference to be held in Lisbon, Portugal on 2 and 3 February. It is interesting to note that this conference was scheduled only after Japan agreed to cooperate with the British industry, which is in a state of stagnation.

Japan is most fearful of America's attitude. When friction between U.S. and Japanese automobile companies became a political problem, the United States strongly insisted that both Toyota Motor Co Ltd and Nissan build their automobile plants on American soil. But the reaction from both companies has remained "negative." In the wake of these events, Nissan's decision to build in England has ruffled the feelings of America the opposite way. The fact is, with the development of the automobile policies of President Reagan's new administration which has just begun, rekindling of the automobile friction problem is inevitable.

At any rate, Japan's automobile industry has met "the rough, blowing storm of internationalization," as exemplified by the tie-in negotiations of Toyota-Ford and Nissan Volkswagen since last year, and it has become the focal point in the realignment of the world's automobile industry. This is proof of the encouragement and confidence gained by Japan's automobile industry.

Yet some quarters feel that the automobile industry is "a little hasty." Consider the Big Three in America and the much publicized managerial crisis of Chrysler Motors as examples: one faulty move in management and in no time the company is stifled. The risks are great because Japan is still green in "internationalization." These problems must be solved first before acquiring the status of internationalization; otherwise the true worth of Japan's automobile industry is in doubt.

Great Britain Is Receptive; EC Is Cautious

In spite of the deep-rooted feeling of wariness toward Japan prevailing throughout Great Britain, the anticipation of an increase in local employment and of technological interchange was suddenly heightened to a rousing reception beyond imagination. This especially raises hopes for success as a milestone in the new Japan-British economic relations.

Soon after World War II, Nissan Motors received technical assistance from Austin Co, one of the predecessors of the present nationally owned BL manufacturing firm (formerly British Leland), and it achieved its present prominence by improving its know-how in automobile production. In other words, since this was a case of the "student" making a reverse landing, for the British the news produced a slightly bitter taste among older people. Moreover, the rightwing conservative newspaper DAILY EXPRESS lamented: "Why should the establishment of a Japanese enterprise in England be supported with our precious tax money!"

Change in Reaction to Economic Move by Japanese

But the British reaction, even during the first day, the 29th, to announcement of the plan changed from an initial feeling of revolt to a subtle softening up,

leading to enthusiastic approval and this sign of a change in accepting Japan's economic move was clearly perceived.

In the afternoon of the 29th, during interpellations in the House of Commons, an opposition party member from an electoral district with a large number of unemployed workers changed the mood of the gathering with his spontaneous appeal: "The site of the plant should be in my constituency." Then, too, the automobile industry and labor unions, while calling for a number of stipulations, in principle declared an inclination toward approval. Press comments were generally favorable, while calling for a balance to relieve the domestic automobile manufacturers. Even the popular newspapers, which featured glaring headlines with "Jap" references to Japan, emphasized the increase in job opportunities and viewed the developments with an extremely cool attitude.

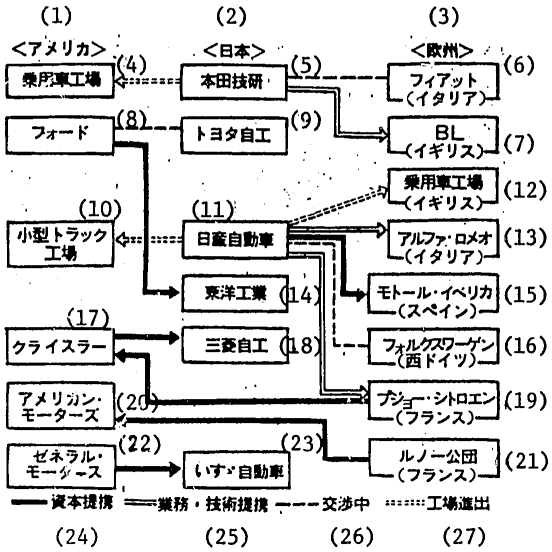
In the background of all these occurrences is the heavily pressing problem of unemployment, which has reached 2.41 million people (an unemployment rate of 10 percent). It appears the main objective of the British Government in approving Nissan's plant construction plan is not only to bolster the consistently stagnating domestic automobile industry with "shock" therapy, but in a broad sense, to strengthen the industrial state reconstruction policy of Prime Minister Thatcher's Conservative Party administration.

Desire To Develop an Independent Technology

The 20 Japanese-financed firms which are already in operation, mainly in Wales and Scotland, have all maintained stable labor and management relations, even including such problematical industries as color television, and they have been highly regarded with an increase in employment of the local populace. Since Nissan has not yet conclusively decided on the site of its plant construction, the areas where Japanese plants are already established have promptly made overtures which reflect the earnest efforts to solve their unemployment plight.

But the truth is that there is nothing palpable anywhere yet that would serve as positive proof of the future smoothness of Nissan's venture. Members of the British automobile world strongly hope that the Japanese manufacturer will unveil a conservative, independent technology in its overseas venture.

Although the British have generally welcomed the move, still remaining is the resistance of the rest of the EC, which feels the threat of Japanese automobiles. Particularly because the British Government's intention is to seek Nissan's cooperation to export its newly manufactured cars to other countries, a clash with EC automobile manufacturers is inevitable. A case in point is France, which was replaced as the ranking foreign exporter in the West German market last year for the first time by Japan. Because all Europe feels pressured by the Japanese, it is anticipated that any action such as preferential treatment in the tax system to be accorded by the British Government to Nissan will be made in accordance with EC practices.



International Relations Between Japanese, U.S. and European Automobile Manufacturers

Key:

(1) United States
(2) Japan
(3) Europe
(4) Passenger car plant
(5) Honda Motor Co Ltd
(6) Fiat (Italy)
(7) BL (Great Britain)
(8) Ford
(9) Toyota Motor Co Ltd
(10) Small truck plant
(11) Nissan Motor Co Ltd
(12) Passenger car plant (Great Britain)
(13) Alfa Romeo (Italy)
(14) Toyo Kogyo Co Ltd
(15) Motor Iberia (Spain)
(16) Volkswagen (West Germany)
(17) Chrysler
(18) Mitsubishi Motor Co Ltd
(19) Peugeot/Citroen (France)
(20) American Motors
(21) Renault Public Corporation (France)
(22) General Motors
(23) Isuzu Motors Ltd
(24) Capital tie in
(25) Administrative/technical tie-in
(26) Under negotiation
(27) Plant construction decided

9510
CSO: 4105

ECONOMIC

ARTICLES REVIEW STOCK MARKET PERFORMANCES

Robot Manufacturer Fujitsu Fanuc

Tokyo SHUKAN SHINCHO in Japanese 22 Jan 81 pp 132, 133

[Text] Are you aware that in the very near future caddies on Japanese golf courses will be replaced by robots? That these robots will be equipped with microcomputers so as to perform such skills as calculating the drop point of the ball right after its impact and then walking over to point out its location? "Moreover, it will even be able to calculate the golfer's ability from only his swing and then determine his handicap!" In all likelihood these predictions must be true since they are being made by robot manufacturing technicians. The technology standard of robot manufacturing today has reached this sophisticated level. And at this moment, the stock price of robot manufacturer "Fujitsu Fanuc" (listed, second section, Tokyo Stock Exchange) has surpassed the record held by Sony Corporation. The record-breaking 6,000-yen mark is the highest recorded in history. According to bubbling Kabuto-cho sources, "with this record, Japan has finally entered the age of robots."

Robots To Build Automobiles

Some segments attribute the progress of the robots, indeed, to the "invader games."

It is reported that, some time ago, a fantastic price was placed on the stocks of an unknown company called "Biatron" on Wall Street. This was because of the company's epoch-making development of the microcomputer, but at that time, for the reason that "no one knew the usage of microcomputers," the product hardly sold. The "Biatron" company tragically went bankrupt. For a long time after that, even in Japan, the talk among stockbrokers was that "microcomputers are anathema" and they never bothered to handle the stocks.

But the fact of the matter is that none other than the portable electronic computer and the invader games were responsible for popularizing a product with such a terrible history. (Note: The added factor was the use of large scale integration [LSI] which constituted the heart of the microcomputer. The invader games, in particular, utilize a great deal of LSI.) As a result, the microcomputer was further reduced in size and price, and, as you are fully aware already, incorporated in television and the automobile, and eventually, as it came to be the brains of the robot, this high-performance microcomputer underwent mass production.

The so-called first robot to achieve practical application was the numerical control [NC] apparatus. It consisted only of a microcomputer attachment on such machine tools as lathes and milling machines.

"They are sold overwhelmingly to small iron works. When purchased by a village shop, the father prepares the program and the mother pushes the button. And since thereafter the microcomputer with automated control conducts the operations, father alone is sufficient."

This is the origin of the robot. In the wake of these NC machine tools, the genuine robot appeared. Included in the group of industrial use robots were those identified as welding robots, painting robots, conveyor robots, among others. It is said that if an NC machine tool is combined with these robots, then a human being is totally unnecessary.

"The automobile and electrical products manufacturers are rapidly undergoing robotization. For instance, in the case of the automobile manufactuer, spot welding is performed at 1,200 points on each automobile, but already the bulk of the work is done by robots. Today robots with such names as Momoe and Junko do welding. Even painting is performed by robots. To attach tires on a completed vehicle, handy robots are already in use which can screw the complete set of nuts and bolts at one time."

Lately officials of automobile manufacturers from the United States and Europe have been actively visiting Toyota Motor Co Ltd and Nissan Motor Co Ltd with proposals of joint operations, but reportedly their eyes are fixed on the "manless plant" rather than on the performance of the vehicles.

At any rate, it is reported that the robot industry, whose development is only recent, already numbers 140 firms, including such big companies as the Yaskawa Electric Manufacturing Co Ltd and the Mitsubishi Electric Corp. And among them the top manufacturer specializing in robots is "Fujitsu Fanuc." It needs no introduction as the subsidiary of Fujitsu Ltd of computer fame.

President Inaba, "Emperor of the Robots"

The firm was established in 1972. Although established only recently, its sales during the past 5 years have increased eight times (at present, 80 billion yen per annum); moreover, it is said that President Seieimon Inaba (55 years old) has already been honored with the sobriquet "emperor" of the robot industry. His business has become a "monopolized industry."

According to a fellow manufacturer of robots: "That man is Japan's foremost individual in the field of NC machine tools. Because, way before the development of microcomputers (1952), the United States Air Force had constructed a mammoth NC machine tool using 18,000 units of vacuum tubes, but only 4 years later the same thing was duplicated in Japan by this man. He was then only a section chief at Fujitsu Ltd."

"Then, after that, Mr Inaba devoted himself to NC machine tools and visited machine tool manufacturers throughout Japan to seek their cooperation. Thus, with the

practical application of NC becoming a reality and even the birth of the robot, small wonder that in the machine tool world Mr Inaba is considered the "founder" and accorded godlike reverence. Sales are made with this overwhelming mark of distinction."

It is reported that he controls 70 percent of the domestic market and 50 percent of the world market. The fact is that the rest of the manufacturers have given up the idea of competing for a share in the mainline machine tool business world, and are engaged in expanding the markets in the automobile and electrical business areas.

So, we paid a visit to the person dubbed the "emperor of the robots" in the main building of Fujitsu Fanuc in Hino City, Tokyo. I am certain that anyone visiting the company for the first time would be astonished. Except for the glass windows, the building is totally yellow. President Seieimon Inaba greeted us wearing a yellow coat. His secretary wore a yellow one-piece dress. The company officials and employees all wore yellow working clothes. Upon inquiry, it was learned that the employees' quarters are also painted bright yellow.

"Isn't yellow a nice, bright color? The trousers worn by the men at the headquarters plant are all different, but at the recently constructed Fuji plant, it was decided that even the trousers will be uniformly yellow."

We wondered if the color scheme was made with the robots in mind; not so, for it appeared to be based on the aesthetic taste of the president. "Our stock price has surpassed that of Sony Ltd, and I consider this to be the logical course. Ours is a company that has striven day and night for a manless plant. We are not deterred by either prosperity or depression. Because we ourselves promoted the establishment of a "manless plant" ahead of others, we have realized profits worthy of that change. We consider our company to be the equivalent of an "outstanding student."

This person was not haughtily relating his success story. He gave the account with a serious mien.

Midnight Work Utilizing Robots

Next a tour of the plant was made. This indeed was the world-famed manless plant wherein so-called robots made robots. Reportedly this company is better known abroad than at home, and among the large stockholders are such giants as "Siemens," "Chase Manhattan Bank" and even "Arab oil interests."

There they were! The principals on the floor of the motor manufacturing flow process at the headquarters plant were ten conveyor robots and automated machine tools. Each robot was given the name of a flower, such as chrysanthemum, lily, etc; and Miss Chrysanthemum had an indicator light that read "24-hour operation." This machine alone literally continued operating for 24 hours. Within the wide plant interior were two or three persons leisurely checking the machines. They work only during the day.

"Workers in Western countries operate on a three-shift system for 24 hours. Japan is the only country bound by the Labor Standards Law. Employees work only during

the day. It seems factories operating 24 hours in Japan are just about limited to iron and steel plants. With such a situation, Japan could never catch up with the Western nations. For this reason, the manless plant was first realized in Japan. The robots say nothing and work silently even in the dead of night."

The most up-to-date Fuji plant, which was completed in late 1980, is even more advanced and at night there are only two individuals to monitor the central command room. (Note: Only the assembling operation of the final processing section has not yet been robotized.)

The number of workers at this company totals about 860. This is about one-fifth the number of workers normally employed by a company of similar size.

An official of the All-Japan Federation of Electric Machine Workers Union, with which the labor union of this company is affiliated, said the following without hiding his bewilderment: "In Europe the penetration of robots in factories has already become the most important issue among the labor problems. But in vanguard Japan, the situation is different. The use of robots does not mean an immediate follow-up of worker dismissals; usually the workers are reeducated to become programmers. Hitherto, programmers were regarded as white collar workers, but conditions have changed, and it may be that programmers may be classified as blue collar workers or that a new classification may be developed."

In passing, the company operates on a 5-day workweek. There is no overtime work. And the pay standards are slightly above average.

Defense-Related Stocks

Tokyo KEIZAI TENBO in Japanese 1 Feb 81 pp 84, 85

[Text] Will Defense-Related Stocks Ever Become Leading Stocks?

Japan's national defense budget has been increased substantially, the Reagan administration with its hawkish image has come aboard in the midst of the heightening of international tensions, and so without doubt it is the opportune time for defense-related stocks to rise, but there has hardly been any indication of movement. In order to find out what has happened, a study of the circumstances surrounding defense-related stocks was made.

Substantial Increase in National Defense Budget

The grand opening of this year began on a wave of prosperity with a sharp gain exceeding 30 yen, and Kabuto-cho officials stated: "This action is a forecast of the future," and the usual big optimistic forecast was released.

"The leaders will be the high-energy stocks represented by electronics."

"High-level technology, which will be more sophisticated than genetic engineering and others, will lead the 1981 market."

Such were the remarks made boisterously to support the analysis, but the defense-related stocks, which were due to become the certain topics of discussion about this time based on past performance, are lacking just one more push in their development. That is to say, circumstances surrounding defense-related stocks would certainly place them in a suitable, transitional position.

Actually, at this point, events that could stimulate defense-related stocks have all at once become plentiful. For instance, the national defense budget totalling 2.4-trillion-plus yen has a percentage increase, compared with the previous fiscal year, of 7.61 percent, which exceeds that of the welfare budget which recently increased in importance with recognition of the aging society; and even with the GNP, although way short of the 1 percent desired by those connected with it, it has reached a relatively high 0.906 percent.

But before the budget was compiled, the demand relayed by American officials was a percentage increase over the 9.7 percent of the previous fiscal year, whereas the Defense Agency demand, in consideration of domestic affairs, was 9.1 percent. Thus when comparing these figures, one cannot easily brush aside the feeling that the percentage increase of 7.6 percent is indeed low, but because the country is involved critically in financial reconstruction, the outcry that the "decision was appropriate" has been overwhelming.

On the other hand, naval ships and aircraft were recognized as "frontal armaments" by a wide margin, and as a result the load in the next fiscal year will be substantially increased, and after the following fiscal year (FY82), according to Defense Agency officials, the shape of things will be: "Even while remaining silent, it has been agreed that a sharp increase of about 10 percent will be virtually promised."

Although Conditions Are Adequate...

As for developments abroad, on 20 January in America, President Reagan and his administration with its strong hawkish image replaced President Carter and his administration with its dovish image. As we all remember, this change was welcomed and right after that the U.S. stock market, especially munitions-related stocks, showed an all-round market advance.

The East-West confrontation which hinges on U.S.-Soviet relations has increased in tension with the passage of time and the prediction is that the policies hereafter will magnify their hawkish images even more. And as expected, the prediction is that there will be stronger voices seeking the strengthening of the defense powers of allied countries such as the Western nations and Japan.

Richard Allen, who is expected to be named national security adviser (probably finalized during publication of this issue), at a press conference with Japanese correspondents in early January stated: "The tasks which must be performed by the United States and Japan, which are the world's leading and second leading super-economic powers, are many, but in any case the solutions must be reached with the focus on the most important issue, which is the maintenance of peace."

So saying, he tacitly called for Japan to further strengthen its defense powers. As mentioned previously, the increase in Japan's defense strength, and following

this the environment surrounding the defense industries, has turned so favorable that no period in the past can be compared. Within limitations, it can be said that conditions for the rapid progress of defense-related stocks are more than amply ripe.

Of course, the sharp-witted people in the securities business would not let this golden opportunity pass by, and several times last year they deliberately attempted to push defense-related stocks into the limelight. But the truth is that these attempts were not fruitful.

This is what happened last year: During the first part of the year, such events as the U.S. hostages in Iran and the Soviet military invasion of Afghanistan intensified international tensions, and in midyear this was further intensified with the outbreak of the Iran-Iraq war; so subsequently great fanfare was raised on occasion for defense-related stocks, but in all cases they fizzled out and these stocks never became leaders.

Also during last year, resources stocks related to the energy crisis, high-technology stocks represented by sharply increasing electronics, and small speculative stocks which were boosted by hawk Ronald Reagan's election all did not lack topicality on each occasion, and perhaps there were times when "attention could not be paid" to defense-related stocks, but it can probably be said that they were not attractive, at least not as much as publicized by the entire securities world.

Incidentally, the defense-related stocks, during last year and even up to the present, have not risen as much in price as they have been widely publicized. And for this reason there has been a lot of talk recently that "defense-related stocks at Kabuto-cho will never make it as leading stocks."

Will This Truly Be the Perennial Theme?

One of the reasons given as to why defense-related stocks at Kabuto-cho cannot be leading stocks is that the defense industry, which is the principal in this case, moves on "mood" so far ahead while not realizing profits along the way. Actually, favorable reports of prosperity that would bring forth a roar from the masses have been circulated from time to time, but then reports of profits going up on this account have never been heard.

Indeed, the acquisitions from up-to-date technologies have their own merits, but this does not mean that "mood" did not prevail over performance. If this is true, then the fact that the popularity of defense-related stocks should end simply as a result of mood is to be expected.

But in addition, the more fundamental issue is believed by some to be the constitutional provision banning rearmament. Regardless of all the fanfare about defense industries or defense-related stocks, this constitutional provision has been the shackle that has blocked taking that one forward step.

"You cannot expect only Kabuto-cho to be beating the drums and clamor defense! defense!" So, admirably, did a securities company official confess the state of affairs. On the other hand, having a peaceful constitution that bans rearmament is also to be expected.

With banner cries here and there, it is likely that defense-related stocks will be the topic of discussion in the stock market from time to time hereafter, but they cannot be expected to become leaders of the whole market; it will probably end at least within the bounds of "prayers being answered," that would augment an insufficiency of theme. Within that limit, shouldn't the perennial theme be described as the admirable expression of Kabuto-cho's image of the issue on defense?

High Technology Stocks

Tokyo KEIZAI TEMBO in Japanese 1 Jan 81 pp 99-105

[Text] As if to symbolize "violent fluctuations in the 1980's," the 1980 stock market was really rocked by a succession of wide fluctuations. The upsurge of speculative stocks as represented by Miyaji Iron Works Co Ltd, the deluge of foreign investments, the purchase of defense-related stocks consistent with the mood of worldwide military expansion based on the Soviet invasion of Afghanistan, the outbreak of the Iran-Iraq war and other events affected the market, and as a result issues that were not expected in the beginning to move, fluctuated heavily. Partly because the resistibility to inflation and the vitality of Japanese business enterprises after the second oil shock were favorably appraised internationally, Japan's stock market has shown a smooth development, and the Nikkei Dow-Jones has shown a continuous upward trend, from 6,560 yen at the beginning of the year to breaking the high mark of 7,000 yen.

What is in store for the new year, 1981? For the majority, a bullish prospect is dominant because of the lively stock investments in a background of financial relaxation. What group of stocks will be active? From among the various theories propounded, the most reliable one now is high technology stocks, which are causing a boom even on Wall Street. In Japan the tempo of R&D has been hastened in the various fields of industry such as electronic computers, software, communications machinery and equipment, energy development related, genetic engineering and electronics, and already signs of a boom are surfacing. In all likelihood, high technology stocks will assume the role of leading stocks in the stock market for the new year.

--Toray Industries Inc

High for year	270 yen	4 November
Low for year	205 yen	11 March
Target price	300 yen	

Determined To Develop Promising Manufactured Products

The largest manufacturer of synthetic fiber. Determined to develop promising manufactured products based on the potential of established high technologies. Among its already developed products are polyester films with shares of audio-use 67 percent, VTR-use 85 percent, top-grade carbon fibers with a 50 percent share of the world's market, among others. Also programmed is the development of interferon, with prospects of mass production in 2 or 3 years.

Forecast of Increased Revenues and Decreased Profits

The intermediate report in September of this period (6 months) showed sales of 267.558 billion yen (an increase of 17.8 percent over that of a year before), a recurring income of 14.22 billion yen (a decrease of 13.6 percent from that of a year before) and profits after taxes of 6.509 billion yen (a decrease of 11.7 percent from that of a year before). Reduced profits are anticipated because of the continued sluggishness of the textile market during the latter period (6 months). The prospects for the current period are sales of 540 billion yen (an increase of 12 percent over that of a year before) and recurring income of 23 billion yen (a decrease of 28 percent from that of a year before).

Movement of Stock Price

Began an upward trend since hitting the bottom at a low of 205 yen last March and closed at a high of 270 yen in November. Since then, there has been a slight buy-at-low tendency and the prevailing price has hovered in the high price range of 260 yen. However, a high price situation is forecast because of many stimulating news items such as a new semiconductor element, interferon, etc. Interest of foreigners is aroused on its reputation as a high technology stock. For the time being, buy at a temporary decline with 300 yen as target.

--The Green Cross Corp

High for year	2,260 yen	26 November
Low for year	1,650 yen	26 June
Target price	2,500 yen	

Total Effort on Development of Two Outstanding New Drugs

A company that grew rapidly mainly with manufacturing blood agents. In recent years priorities have been placed on the R&D of artificial blood and interferon. Approval for manufacture of artificial blood (fozol DA) has already been obtained and the construction of facilities is expected during the latter half of 1981. On the other hand, the commercialization of interferon is advancing at a rapid pace and recently a test plant was constructed and put in operation.

Trend Toward Increased Earnings

The intermediate report completed last June showed sales of 28.163 billion yen (an increase of 37 percent over that of a year ago), recurring income of 5,286 billion yen (an increase of 21 percent over that of a year ago) and a profit after taxes of 2.158 billion yen (an increase of 17 percent over that of a year ago). The latter period is expected to undergo a smooth transition; for the current period, the prospects are sales of 58 billion yen (an increase of 27 percent over that of a year ago) and a recurring income of 10.4 billion yen (an increase of 17 percent over that of a year ago).

Movement of Stock Price

Prices took on a rising trend from a low of 1,650 yen in June to reach a high of 2,260 yen in November. The prevailing price has dropped 100 yen, to the 2,160 yen range. However, with artificial blood and interferon, company performance as

well as stock price, to follow through with the two outstanding news items, an increase of one more step can be expected. With rights to 10 percent free shares at the end of this period (December 1980, the target price is 2,500 yen.

Mass Production Is Problem With Interferon

Eagerly awaited as the "miracle anticancer agent" is interferon. An intense competition for its development is being waged throughout the world today. Interferon is an artificial micro-organism which is made from genetic manipulation and it is a promising product in the field of genetic engineering that ranks alongside insulin (reportedly a highly effective agent for curing diabetes) and others.

As to the state of development in Japan, the Green Cross Corp and Toray Industries Inc have been involved on a commission by the Research Development Corporation of Japan, and various research activities have been conducted including clinical demonstrations at the National Cancer Research Institute, (Zaihara Seitoku?) Research Institute, etc.

The effectiveness of interferon has been recognized even at the above-mentioned medical society. but the problem is that technology for its mass production has not yet been established. It is worthy of note that in late November last year it was announced that a Japanese researcher at the U.S. National Health Research Institute had developed a method to mass produce artificial micro-organisms; and so the advent of the era of mass supply and demand, it appears, is not far away.

Reportedly a minimum of 250 million to 500 million units of interferon is needed to treat a cancer patient and the Green Cross Corp and Toray Industries Inc, which are Japan's principal companies engaged in its R&D, have the objective of producing 4 billion units per month by 1984.

--Ajinomoto Co Ltd

High for year	794 yen	1 December
Low for year	510 yen	18 March
Target price	800 yen	

Leader in the Field of Amino Acids

In genetic engineering, the company is engaged in applied research in its forte, amino acids. Already by utilizing its technique, it has begun to make the world's first new type colon bacilli with which to produce pure amino acids. In amino acid research, the company expects to follow up and sell new products within 2 or 3 years. These are amino acid sweetener matter, anticancer agent (renchinan) and the like which are eventually expected to be large-scale commercial products.

Continuously Rising Pace

The intermediate report in September showed sales of 174.445 billion yen (an increase of 7.4 percent over that of a year ago), recurring income of 11.083 billion yen (an increase of 11.3 percent over that of a year ago) and a profit after taxes of 4.841 billion yen (an increase of 18.4 percent over that of a year ago). The latter period is expected to undergo a smooth transition; for the

current period, sales are expected to be 380 billion yen (an increase of 7 percent over that of a year ago) and a recurring income of 23 billion yen (an increase of 5 percent over that of a year ago).

Trend of Stock Price

The price took an upward trend from a low of 510 yen in March to reach a high of 794 yen in December. After that there was a slight buy-at-low-price trend, and the prevailing price will be in the high range of 760 yen. For the time being, the 700 yen level may continue, but with a good number of excellent new items such as amino acid sweetened matter, development of an anticancer agent, genetic engineering, etc, when the occasion presents itself, its popularity will rise. Watch for a lower price (to buy) with a target price of 800 yen.

--Kyowa Hakko Kogyo Co Ltd

High for year	538 yen	1 December
Low for year	358 yen	11 March
Target price	600 yen	

Pioneer of Fermentation Chemistry

With fermentation technology as the basis, engaged in diversification and production of spirits and alcoholic liquor, glutamic acid soda and medicinal products; attained world ranking status in technology utilizing micro-organisms. Its latest development which has drawn attention is the technology utilizing biological functions. This is an opoch-making technology to make medicinal products such as interferon, and foodstuffs through genetic manipulation or mass culture of enzymes, and future expectations are great.

Increased Profits at a Narrow Range

The intermediate report which ended last June showed sales of 13.285 billion yen (an increase of 28.6 percent over that of a year ago), a recurring income of 4.702 billion yen (an increase of 4.8 percent over that of a year ago) and a profit after taxes of 1.843 billion yen (an increase of 14.3 percent over that of a year ago). The latter half is expected to have a smooth transition, and for the current period the prospect is for sales of 25 billion yen (an increase of 18 percent over that of a year ago) and a recurring income of 8.9 billion yen (an increase of 4 percent over that of a year ago).

Trend of Stock Price

It took an upward trend from a bottom of 358 yen in March last year to a high price of 538 yen in December. After that, there was a slight buy-at-low-price trend and the prevailing price has been in the high price range hovering around 510 yen. But with news value items such as genetic engineering, development of new medicines, etc, which are in keeping with the times, a one step higher development is anticipated. The stringency in supply and demand caused by foreign purchases and institutional purchases is a plus factor. For the time being, the target price is 600 yen.

Biotechnology Possesses Tremendous Attraction

Recently the market has been flooded with such expressions as biomass (biological energy) and biotechnology (biological engineering). The field of control of vital phenomena by man belongs to genetic engineering, but it is said that the future of this field is extremely close to that of medical science, agriculture and industry.

According to the survey conducted by the American survey organ, "Chemical Marketing Reporter," the sales of products based on the new technologies springing from biomass and biotechnology will probably reach about 6 trillion yen on a world scale by 1985.

Japan has constructively begun these technologies with the chemical industry taking the lead. Beginning with the establishment of a "biotechnology discussion group" made up of top officials from the Big Five companies--Mitsubishi Chemical Industry Co Ltd, Sumitomo Chemical Co Ltd, Mitsui Toatsu Chemicals Inc, Asahi Chenical Co Ltd, and Kyowa Hakko Kogyo Co Ltd--results are about to be realized at the research institutes of such companies as Kikkoman Shoyu Co Ltd and Ajinomoto Co Inc of the foodstuff industry.

Even MITI's Agency for Industrial Science and Technology has its eye on establishing a "System to Develop Industrial Base Technologies for the Next Generation" and it has clearly announced its objective of an investment of 31 billion yen for a 10-year plan beginning with FY81. With government and private industry working together, the program has finally gotten underway.

--Pioneer Electronic Corporation

High for year	2,500 yen	17 September
Low for year	1,680 yen	10 March
Target price	3,000 yen	

A Pioneer in Video Disks [VD]

At present the world's largest manufacturer of VD. Also leading in software production, which is the key to its VD growth. Being sold already in 17 U.S. cities; company expects to expand throughout the United States in 1981 with an annual sale of 100,000 units totalling 8 billion yen. Although RCA system and VHD system products of other companies are expected to appear on the market, the company at that time intends to sell its already popular brands.

Continuously Rising Pace

During the previous period which ended in September, sales totalled 224.633 billion yen (an increase of 23.8 percent over that of the previous period ending in September 1979), a recurring income of 28.816 billion yen (an increase of 27.3 percent over that of the previous period ending in September 1979) and a profit after taxes of 15.081 billion yen (an increase of 24.2 percent over that of the previous period which ended in September 1979). A continuous rise is expected during this period with sales forecast at 265 billion yen (an increase of 18 percent over that of the previous period which ended in September 1980) and recurring income of 31 billion yen (an increase of 7 percent over that of the previous period which ended in September 1980).

Trend of Stock Price

From a low of 1,680 yen as bottom in March, it took on a rising trend to peak at a high of 2,500 yen in September. After this, there was a slight buy-at-low trend, but the prevailing price has remained in the high price range of around 2,430 yen. The public offering to increase capitalization is taking place during this period (payment by 24 December) and so a perceptible price movement cannot be expected; however, after this is over, a gradual increase in price will occur with interest in the 25 percent free shares (expected during the latter part of this period).

--Victor Company of Japan Ltd

High for year	2,870 yen	21 November
Low for year	1,860 yen	8 October
Target price	3,500 yen	

A Leader in VD

It is tops in VTR sales and has continued its fast growth with this item as its mainstay. Its VTR sales jumped from 8.3 billion yen in FY76 to 170 billion yen in this fiscal year, and the sales percentage will leap from 6 percent to a little more than 50 percent. On the other hand, regarding VTR, the company's VHD system is outstanding, and besides forming a joint corporation in the United States with Matsushita Electrical Industrial Co Ltd, General Electric and other companies, it expects to sell its products during the latter half of 1981.

Very Favorable Business Performance

The September intermediate report of this period showed sales of 166.093 billion yen (an increase of 48.2 percent over that of the previous year), a recurring income of 14.526 billion yen (an increase of 98.3 percent over that of the previous year) and a profit after taxes of 6.188 billion yen (an increase of 2.1 tiems that of the previous year). The performance of the latter half is expected to exceed that of the first half, and the current period is expected to have sales of 355 billion yen (an increase of 40 percent over that of the previous period) and a recurring income of 31 billion yen (an increase of 60 percent over that of the previous period).

Movement of Stock Price

After the stock dividend of shares sliding down in October, from a low of 1,860 yen the price rose to a high of 2,870 yen during the latter part of November. The prevailing price, with a drop of 150 yen, is around 2,720 yen. However, with favorable performances, there will be increased dividends during this period and with an anticipated 10 percent free shares in late September of 1981, a renewal of high prices is expected. With VD being readied as the growth product to succeed VTR, for the time being the target price is 3,500 yen.

Biggest Leader Possibly During the 1980's

Dubbed "records with visual output," video disks will finally be in production this year. Already advance publicity has been committed and some of the makers have already launched a sales campaign in the United States, but in Japan the prevailing sentiment among those in the industry is for self-restraint until uniformity of specifications is first established; none have reached the stage of production as yet.

For the present, the three prevailing systems are the optical system (developed by the Phillip Co of Holland), CED system (needle type with grooves, developed by RCA Co of the United States) and the VHD system (grooveless, developed by Victor Company of Japan, Ltd), but the overwhelming majority of private businesses in Japan prefer the VHD system. Production of the optical system of Pioneer Electronic Corp and the CED system of Sanyo Electric Co Ltd and Hitachi Ltd has already commenced, but they are not uniform with the VHD system, which is overwhelmingly greater in terms of quantity, and so the strong possibility exists of the VHD system being essentially referred to eventually as the "Japan specification."

VD requires not only the substance but also the manufacture of the software (the records) and preparation is essential. But a genuine commercial battle is expected to be waged during 1981.

--Hitachi Ltd

High for year	353 yen	15 October
Low for year	231 yen	29 March
Target price	400 yen	

Huge Sums Invested for Research

A giant business corporation of world stature the likes of which are very few even in Japan. Above all, it excels in technology development strength and employs about 7,000 technical experts under the motto of establishing independent technologies. It invests a sum reaching 100 billion yen annually for R&D. Backed by this gigantic R&D program, it is engaged in active development in the fields of electronics and energy, and among other things, it is peerless in semiconductor applied technology.

Business Performance Is Excellent

The intermediate report in September of this period showed sales of 977.654 billion yen (an increase of 17.4 percent over that of the previous year), a recurring income of 57 838 billion yen (an increase of 12.2 percent over that of the previous year) and a profit after taxes of 29.825 billion yen (an increase of 16.8 percent over that of the previous year). Indications are that the performance of the second half will surpass that of the first half. The forecast for the current period is an increase of 10 percent over that of the previous period in increased revenues and an increase of 12 percent over that of the previous period in recurring income.

Trend of Stock Price

From a low of 231 yen in March, the price took an upward swing and in mid-October with foreign purchases it reached a high of 353 yen. After that, adjustments followed with enforcement of the new foreign exchange law and the current price is around 310 yen. A high growth is expected to continue hereafter with emphasis on the highly profitable electronics field. With its excellent reputation abroad as an international company, the renewal of high price described previously can be expected. For the time being, the target price is 400 yen.

--Sharp Corporation

High for year	715 yen	30 October
Low for year	511 yen	27 March
Target price	800 yen	

To Engage in Future Technologies

One of the giants in home electrical goods manufacturing. It has expanded its operations in recent years to place emphasis on such industrial equipment as semiconductors and information terminals. It has an established reputation in semiconductor applied technology and has been producing home electrical products and unique office appliances. Besides these products, it is engaged in future technologies such as sensors, optical communication, display apparatus, semiconductors and lasers.

Favorable Business Performance

The intermediate report in September of this period showed sales of 246.528 billion yen (an increase of 26 percent over that of the previous year), a recurring income of 14.279 billion yen (an increase of 18.9 percent over that of the previous year) and a profit after taxes of 8.02 billion yen (an increase of 28.2 percent over that of the previous year). A smooth transition is anticipated for the second half, and for the current period sales of 495 billion yen (an increase of 25 percent over that of the previous period) and a recurring income of 30 billion yen (an increase of 27 percent over that of the previous period) are expected.

Trend of Stock Price

The price rose from a low of 511 yen in March to a high of 715 yen in late October. The prevailing price dropped less than 50 yen to the 660 yen range. But the company performance is still good, and being a high technology stock, the price is expected to rise again to the previous high. For the time being, the target price is 800 yen, but buying by foreigners is expected to continue and so a long-range expectation of reaching 1,000 yen is not a mere dream.

Unlimited Growth Potential Inherent in IC

Reportedly the semiconductor industry has a continuous growth potential of 20 percent per annum. Since 1979, an imbalance in supply and demand has continued worldwide and the various manufacturers in Japan have continued to be in full production.

Generally, semiconductors are classified as discrete semiconductors, IC and LSI, or as transistors and diodes. Recently discrete semiconductors have lagged, but on the other hand, the demand for IC and LSI has increased sharply and they are about to attain a high growth average of 35 percent per annum. This is attributable to an expansion of markets, with all sorts of products from home electrical appliances to information equipment and automobile components centered around watches, cameras, radio equipment, communications equipment and electonic computers. It is confirmatory that this trend will continue hereafter because of their inherent unlimited growth potential.

In a worldwide sense, because the United States is the birthplace of semiconductors, it is slightly ahead of Japan insofar as such factors as basic technology and manufacturing facilities are concerned, but from the standpoint of mass production technology and quality, Japanese products are superior, and originator America has strongly felt the threat of Japanese inroads. Japanese manufacturers who feel that Japanese exports are only causing half-hearted excitement are competing for a changeover to engage in production abroad. This is the year for achievement of this "international strategy."

--Fujietsu Ltd

High for year	327 yen	1 December
Low for year	278 yen	March
Target price	400 yen	

All-Out Decision on Robot Manufacturing

The company plans to diversify from special steel materials to bearings, tools, machinery and industrial furnaces. A standout above all are the industrial robots. They are the forerunners of labor saving, and interest in the demand for their use by the industrial world has been increasing every day. To meet this expectation, the "Uniman 6,000 Series," which up to now has had wide usages from handling to welding, has been improved. The company has gone all out to produce robots with new functions.

Favorable Business Performance

The previous period ended in November and figures are still being tabulated; however, besides tools, there were other items which produced profits, and increased production was fully realized. Forecast are sales of 91 billion yen (an increase of 26 percent over that of the previous period in 1979), recurring income of 4.6 billion yen (an increase of 56 percent over that of the previous period in 1979) and a profit after taxes of 2.2 billion yen (an increase of 75 percent over that of the previous period in 1979). A continuous increase for the present period is predicted with sales of 105 billion yen and recurring income of 5.5 billion yen.

Trend of Stock Price

From a low 278 yen in March, the price took an upward trend and reached a high 390 yen in July, which was attributable to the popularity of robotic technology stock and public offering. But after that, a loss of popularity led to the prevailing price dropping from the public offering price of 330 yen to around

320 yen. However, with the expectation of another public offering in 1981 and a continued gratis offering every 6 months, an upward trend is expected. For the time being, the target price is 400 yen.

--Yasukawa Electric Manufacturing Co Ltd

High for year	400 yen	14 November
Low for year	185 yen	28 March
Target price	450 yen	

A New Look as a Labor-Saving Machinery and Equipment Manufacturing Co

Although famous as an electric motor manufacturer, with fast growth in electronics and labor-saving machinery and equipment manufacturing in recent years, the company is about to change its image. The big reason for this is the fast growth of NC apparatus and industrial robots. The monthly production of NC apparatus rose from 20 units in FY76 to 400 units in FY81; on the other hand, with industrial robots (principally for arc welding) the monthly production increased from 30 units during the first period to 50 units during the second period.

Renewal of Dividend Payment During This Period

The intermediate report in September of this period showed sales of 37.262 billion yen (an increase of 11.2 percent over that of the previous year), a recurring income of 1.354 billion yen (an increase of 3.1 times that of the previous year) and a profit after taxes of 1.398 billion yen (an increase of 2.9 times that of the previous year). A smooth transition is expected during the latter half; also during the current period the increased revenue is expected to be 14 percent over that of the previous period, the recurring income 90 percent over that of the previous period, and the increased profit after taxes 74 percent over that of the previous period. And a renewal of the payment of 3-yen dividends is expected.

Trend of Stock Price

From a low of 185 yen in March, the price moved upward to a high of 400 yen in November. The prevailing price dropped less than 50 yen, to the 350 yen range. However, with the manufacture of such growth products as NA apparatus, robots, servo motors and sequence controllers, which will be leaders in the 1980's, a high price is sure to be attained. For the time being, the target price is 450 yen.

Industrial Robots Entering Era of Full-Scale Development

Industrial robots have drawn attention as the favorite for the labor-saving era and tremendous strides have been made. The output in 1977 was 21.6 billion yen, whereas the output in 1980 reportedly will reach 60-65 billion yen. It can be said to have reached the popular stage of full-scale operation.

The Committee to Scope the Industrial Robot Vision for the 1980's of the Japan Industrial Robot Industry Association has released figures on its demand forecast from 300 billion yen in 1985 to 600 billion yen in 1990, but many in the industry believe these figures will be surpassed.

Because it is such a promising industry, the number of companies engaged in its manufacture have increased and today there are close to 40 firms. Japan is reportedly the world's frontrunner in technological strength and is now considered running abreast with the United States.

There are many types of robots with varying functions, but hereafter their uses will be more encompassing. Their predominant use right now is in the automobile and electrical industries, but hereafter it appears that they will be utilized in all sorts of manufacturing industries, in nuclear power related industries, medical services, oceanic development, etc. It is entering the era of full-scale operational development.

--Okuma Machinery Works Ltd

High for year	752 yen	15 August
Low for year	603 yen	19 May
Target price	750 yen	

Long Established in Machine Tools

It is Japan's representative manufacturer in the machine tool industry and its NC lathes are top ranking. The Nc apparatuses which have the pivotal function in the NC lathes are produced within the company, which gives it a big advantage over competitors without this capability. Other machine tools manufactured here are grinding machines and machining centers (MC). At any rate, the company is in favorable condition, riding the crest of the machine tool boom.

Orders Are of High Standards

Orders that will be the business index hereafter have continued to be of high standards. The remainder of the order at the end of the intermediate period in September was 11.7 billion yen, which is an increase of 55 percent over that of the same period in the previous year. The order for NC lathes, the principal source of earnings, for the latter half increased, and earnings of 58 billion yen are anticipated for the current period (an increase of 41 percent over that of the previous period). A favorable performance for this period with sales of 54 billion yen (an increase of 42 percent over that of the previous period) and a recurring income of 9.2 billion yen (an increase of 42 percent over that of the previous period) are forecast.

Trend of Stock Price

From a low of 603 yen in May, the price took an upward trend and reached a high of 752 yen in mid-August. But after that, a loss of popularity resulted in the prevailing price of around 610 yen in the low range. And as for elevating the business performance, for a while the stock price will remain in the 600 yen area because the stock price has been discounted. However, with world recognition of its NC and MC machine tools, a resurgence of its popularity is anticipated, making its target price 750 yen.

--Toshiba Machine Co Ltd

High for year	590 yen	3 October
Low for year	406 yen	28 January
Target price	600 yen	

Forte Is Large Machine Tools

This subsidiary of Toshiba Corp is Japan's largest machine tool manufacturer. Its line of machine tools include [projector forming machines?] and printing machines. The machine tools manufactured by this company are individually top ranking or share close to top ranking honors with other companies. Above all, its forte is large machine tools and it is peerless in this field. Besides, its performance is so outstanding as to easily rank it as one of the world's three largest manufacturers.

Business Performance Is Favorable

The intermediate report in September of this period showed sales of 40.910 billion yen (an increase of 14.6 percent over that of the same period of the previous year), a recurring income of 2.881 billion yen (an increase of 46.9 percent over that of the same period of the previous year) and a profit after taxes of 1.504 billion yen (an increase of 85.9 percent over that of the same period of the previous year). The performance for the second half is predicted to be about the same as that for the first half; for the current period sales of 82 billion yen (an increase of 13 percent over that of the previous period) and a recurring income of 5.6 billion yen (an increase of 20 percent over that of the previous period) are forecast.

Trend of Stock Price

From the bottom price of 406 yen, it took an upward trend to reach a high of 590 yen in October. The current price is around 530 yen, which is 10 percent lower than the high. However, with lots of good news items such as a favorable business performance, issuance of 10 percent free shares during the latter part of the period, the development of an applied composite system of a superhigh performance laser, etc, a price recovery is anticipated. With improving popularity as a high technology stock, a high price renewal will not be a dream. For the time being, the target price is 600 yen.

Orders Reflect No Decline in Machine Tool Market

The increase in orders for machine tools shows not even the slightest sign of decline, and this trend is continuing even into the new year. Orders for the entire machine tool industry during the first half of 1980 showed an increase of 49 percent over that for the same period of the previous year, and it is reported that an increase of more than 50 percent might be recorded for the year.

Of the factors that have brought about this state, one is Japan's automobile industry, which broke the world's record in production of cars, and the other is exports. The predominant exports are labor-saving machinery for the automobile

and aircraft industries of the Western countries. To accomplish this, orders for lathes and machining centers have increased sharply. Even within Japan, with industries heavily focused on rationalizing, with investments on facilities and investments for labor saving, orders for machine tools have increased.

The performance for the first half of 1980 showed that of the total amount of orders, that for NC machine tools was 147.3 billion yen or an increase of 77.8 percent over that of the same period of the previous year. Estimates in the business world for total orders for 1980 have been 520 billion yen, but the strong possibility of this figure being surpassed has loomed stronger.

Even in 1981, with the intensification of the world's automobile conflict or the aircraft industry and others being drawn into military expansion, the momentum for purchases of machine tools does not seem to be declining. Of course, the fear of trade frictions arising from an increase in exports will remain.

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CSO: 4105

SCIENCE AND TECHNOLOGY

HITACHI TO DEVELOP INTELLIGENT ROBOTS

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 pp 1,3

[Text]

Hitachi, Ltd., Japan's top general electric machinery maker, has marshalled 500 of its key technological experts in a project to fashion a so-called "intelligence robot" for undertaking assembly tasks.

The company figures to have such proficient robots take over 60 per cent of its assembly production five years hence with the aim of eventually realizing all-out plant automation.

The new robot will use a micro-computer for its "brain," possess faculties for "seeing" and "feeling," and be capable of moving or walking in accordance with the needs of a production line.

After incorporating such a robot into its production system, the company hopes to standardize them for commercial sale.

Hitachi has turned to exerting utmost efforts to conceive a versatile robot from the conviction that automation and labor-saving in the assembly phase of production will become the most crucial point in boosting productivity in the 1980s.

In analyzing work at 17 of its plants, the company has found that the share of assembly jobs reaches 35 per cent of the standard working hours of its employes. Mechanical work ranked next at 15 per cent, inspection work 10 per cent, and various kinds of other work taken together, 40 per cent.

The robot automation plan envisages reducing those employed in assembly work by 70 per cent from now, on the one hand, and raising productive capacity by the same percentage, on the other.

It considers that a shortage of software workers will arise in the future, and many of the retained blue-collar workers can be shifted to this field of work.

Thus, five year's hence, blue-collar workers will disappear from the assembly phase, and the time will come when plants may be operated solely by white-collar workers, it feels.

The themes of the robot project are: 1) standardization of the assembly robot; 2) development of a tool to become the arm and leg of the robot; 3) consolidation of robot software; 4) development of needed sensors for the robot.

CSO: 4120

SCIENCE AND TECHNOLOGY

USSR PROPOSES TECHNOLOGICAL COOPERATION WITH JAPAN'S ROBOT MANUFACTURER

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 9 Mar 81 p 6

[Article: "Industrial Robot: USSR Proposed Technological Cooperation With Japan's Robot Manufacturer"]

[Text] The Soviet Government recently asked the Japan Robot Manufacturing Company, Inc. (JRM) to participate in cooperative venture in the field of industrial robot technology. The head office of JRM is located in Tokyo and is headed by Kenro Motoda. It is capitalized at 50 million yen. The Soviets said that they sought Japan's robot technology because they considered it urgently necessary to increase their productivity through rationalization and labor-saving efforts, and to relieve factory workers from dirty work. The Soviet Government is currently constructing a large-scale robot manufacturing factory in the suburbs of Moscow, and is thinking of importing Japan's robot technology to use in this Moscow factory. Although the details of the Soviet proposal to JRM are not clear, the Soviets are believed to be planning to import Japan's most advanced electronic technology in this field, which includes visual and tactile robot sensors.

Earlier this year, the Soviets proposed technological cooperation with the Mitsubishi Heavy Industries, Ltd. in the field of industrial robot technology. This is the first time, however, that the Soviets suggested technological cooperation with a manufacturer that specializes in robots. Based on this, it is considered that the Soviets have begun vigorous efforts to carry out technological exchange with Japanese robot manufacturers.

In the JRM venture, the Soviets wish to acquire robots for handling operations. They are particularly interested in the sensor technology that is essential for handling operations. They also intend to import the microcomputer technology which controls robots based on information obtained through sensors.

Under the 11th Five-Year Plan (1981-85) draft, the Soviet Government has established a goal to raise productivity through factory automation and to relieve factory workers from dirty work under unfavorable working conditions. To achieve this goal, the Soviet Government is promoting an effort to supply industrial robots to factories on a massive scale. The Soviets are building a large robot factory in the Moscow suburbs and are developing a plan to concentrate all of the world's most advanced robot technologies in this factory.

JRM was established in fall 1979 as an independent company formed from the robot department of Motoda Electronics (the main office of Motoda Electronics is located in Tokyo and headed by Kenro Motoda. It is capitalized at 20 million yen), and Toyo Terminal. JRM is a medium-size company with an annual sales totaling 2.5 billion yen. It has exported its independently developed handling robots to Sweden's automobile maker Volvo and to the Soviet Union. JRM is also developing various position sensors and systems which simultaneously control multiple robots. JRM considers that the Soviets have appreciated the company's achievement. JRM has already started negotiations with the Soviets and is expecting that both parties are expected to continue their negotiations.

Last year, the Japanese robot industry manufactured 22,000 robots and sales totaled 62 billion yen. It is reported that Japan now has 75,000 operating robots, that is, 70 percent of the total number of robots in the world. Robot production is expected to increase at an annual rate of 40 percent for a while and is projected to reach 300 billion yen in 1985. Because the Soviets are very interested in Japan's robot technology which is the most advanced in the world, there is a strong possibility that the Soviets will propose cooperative ventures with other robot manufacturers.

CSO: 4105

SCIENCE AND TECHNOLOGY

CURRENT RESEARCH IN NUCLEAR FUSION OUTLINED

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 3-9, 13-14, 16, 20-23 Jan 81

[5 Jan 81 p 12]

[Text] Attention Paid to "Gamma 10"

Construction on the new "Gamma 10" plasma experimental facility was started in December of last year (1980) at Tsukuba University, which is located in the Tsukuba Research and Academic City in Saitama Prefecture. "Gamma 10" was named for the famous Tsukuba product "4.6 gamma"; among the many nuclear fusion research facilities which are in operation, it is unique in that it employs the "open system mirror type" which recently has been drawing the attention of many countries of the world engaged in this research. "We hope to use this facility to produce work which ranks with the best in the world." These were the words of Professor Shoichi Miyoshi, who heads plasma research at this university.

The initial difficulty we faced when we started out to "can the sun" and make nuclear fusion fire available for our benefit was just how to contain this high-temperature plasma. Most of the efforts expended in nuclear fusion research are directed at developing methods for "confinement" of the fusion reaction. Within the high-temperature plasma, naked atomic nuclei and electrons race around at speeds of several hundred kilometers per second and sometimes several thousand kilometers per second. If left untended, the plasma will be dispersed in all directions. The plasma has to be confined for a fixed duration at high density in a very small space in order to initiate the nuclear fusion reactions.

Ordinary gas can be contained in a cylinder. A cylinder will not do for the containment of high-temperature plasma. The high temperature will melt the container, but this is not all that will happen. The plasma will cool and no longer be able to perform its function.

Even though we talk about high-temperature and high-pressure plasma, its density is far less than that of air. The 100 trillion particles per cubic centimeter, which is the "critical" concentration of these plasma particles, is still but one/one hundred thousandths the density of air. This is why the total heat content (calories) is small. The total heat content of the 100 million degree plasma of roughly 60 cubic meters that will be confined in the nuclear fusion facility "JT-60" at the Japan Atomic Energy Research Institute is approximately

equivalent to the heat contained in a bath for home use. Should any of the particles collide with the walls, there will be an immediate decrease in temperature.

Simple Construction Is the Feature

Is there some means of confining this plasma so that it will not come in contact with the container? The answer to this question lies in the method of using a magnetic field. Magnets are installed around the container, and a strong magnetic field is created. The particles charged with electricity are subjected to pressures exerted by the magnetic field, and the atomic nuclei with plus charges and the electrons with negative charges that are present in the plasma are sealed in within this magnetic field. They are bound in by the magnetic lines of force which encompass them.

This method is generally called the "magnetic confinement method." "Gamma 10," construction of which has just begun at Tsukuba University, also has adopted this confinement method. The unique feature of this facility is the creation of a magnetic field with straight lines of force, and two sites along this magnetic field are squeezed in by a ring of magnets. This creates a magnetic field with a bulge in the middle, and the plasma is confined within this bulge.

Since both ends of the magnetic field are open, this is called an open-end system, and this setup serves as a "mirror" to reflect the particles back, as a result of which there is very little leakage of plasma at these ends. The construction is simple, and it is a very advantageous feature from the standpoint of the construction of the facility.

The more popular "magnetic confinement method" uses a doughnut-shaped container (torus) to confine the plasma, and ring-shaped magnets are aligned along this torus. Since the magnetic field used here has no open end, this mode is referred to as a closed system in contrast to the open system described above.

Eventual Winner in Doubt; Competition Is Fierce

The ace in the present picture is the "Tokamak reactor." The confinement effect by the "magnetic confinement method" varies considerably with the manner in which the magnetic field is created. The Tokamak, which was devised by the Soviets, has an exceptionally good confinement effect. The large nuclear fusion experimental facilities which the United States, Soviet Union, West Germany, and Japan are competing to construct all are of this Tokamak breed.

"The superiority of the Tokamak concept is recognized, but it is too early to say that nuclear fusion in the future will be limited to the Tokamak approach" is the strong statement attributed to Professor Mitsuji Takao, head of the Heliotron Nuclear Fusion Laboratory at Kyoto University.

This center is the site where, last spring, the construction of the independently developed nuclear fusion experimental facility "Heliotron E" was completed. This is a large facility with a torus diameter of 4.4 meters; no magnets are ringed

around the torus, but coils (helical coils) are wound directly in the manner of intersecting headbands. The magnetic field tests conducted in September of last year succeeded in attaining a maximum temperature of 12 million degrees, whereby 76 trillion particles were confined within a cubic meter for a confinement period of 11 milliseconds.

There are advantages and disadvantages to each type of "magnetic confinement method." Tokamak, which is the so-called ace at the moment, has difficulty providing continuous operation. This is why there is a need not to put every effort into developing the Tokamak concept, but to investigate different types, looking at their advantages and disadvantages with the future in mind. This is the strong sentiment reflected from many quarters headed by Professor Takao.

At the present time there is a varied assortment of "magnetic confinement methods," including the Tokamak, heliotron, and mirror types, and also the stellarator, stereo magnetic axis, bumpy torus, and inverted magnetic pinch types; further, there is the aspect of a wide-open field. A final decision has yet to be made from these candidates, including the present leading contender Tokamak.

[6 Jan 81 p 13]

[Text] A beam of light flashed for a moment in an absolutely dark chamber. A cracking sound was heard. When the lights were turned on, it was found that a small hole had been formed at the center of the copper material which had been used as the target. A laser beam which had been shot from a laser facility had made this hole instantaneously in a piece of copper about 1 millimeter thick.

This is the Osaka University Laser Nuclear Fusion Research Center, located at Suita outside of Osaka. "We perform such demonstration experiments occasionally for the benefit of visitors. This is a good display of the power which can be derived from lasers in a readily observable manner." This was the statement of Assistant Professor Kazuo Imasaki, who served as guide at this center, as he stook alongside the "Gekko II" laser facility which he had just fired.

Laser Compression

The confinement of high-temperature laser for a fixed duration is a herculean task in the execution of the "magnetic confinement method." Furthermore, a tremendous effort is required to generate a temperature on the crder of 100 million degrees. Is there no simple method? The laser nuclear fusion concept is an attempt in this direction.

In the laser approach to nuclear fusion, the fuel in the form of deuterium (D) and tritium (T) is placed in a small glass sphere 300 microns (0.3 millimeter) in diameter. A high-energy laser beam is directed at this fuel-containing sphere. This heats the deuterium and tritium to form plasma, and the plasma expands at an astounding force. At the same time, a strong pressure is applied toward the inside of the fuel capsule as a counteraction to the swelling, and this causes the center section of the fuel capsule to be compressed.

The density and temperature of the plasma at the center section of this capsule rise sharply, and there is an increase to a super-high temperature of over 100 million degrees and a density of 1,000-10,000 in the very short time of under one nanosecond (one-billionth of a second). When these conditions are attained, the so-called D-T nuclear fusion reaction takes place, and vast energy is generated.

There Are No Technological Obstacles

Because this method proposes confinement (inertial) of the nuclear fusion fire by the explosive and compressive "explosion-compression" property of lasers, this method is referred to as the "inertial confinement method," as contrasted to the "magnetic confinement method." Where the "magnetic confinement method" has a history of 25 years of development behind it, the "laser confinement method" has a background of 10 years at best. It is a "young" technology. On the other hand, this technology has recently been developing on almost equal terms with the "magnetic confinement method" development.

The "inertial confinement method directed at nuclear fusion reactor development is faced with far less technological obstacles than the magnetic confinement method." This statement was made by Professor Chiyobei Yamanaka, director of the Laser Nuclear Fusion Research Center.

A laser nuclear fusion reactor is a sphere made of stainless steel. Its construction is far simpler than that of the doughnut-shaped structure required by the "magnetic confinement method." Furthermore, there is no need for giant magnets, and the construction to guard against the radiation generated by the fusion reaction can be set up in simple manner. Looking at the future, it is said that a fusion reactor of the magnetic mode must be of the order of a 5 million kW thermal output facility in order to be economical. In contrast, an "inertial confinement method nuclear fusion reactor" can be economical even at 1 million kW thermal output, and a more compact and easily operated facility is possible.

One Megajoule Required

While the situation looks promising at first glance, the situation is not without problems. One of the bottlenecks is that as yet no laser has been developed that can deliver the power necessary to incite the nuclear fusion within the fuel capsule.

A megajoule (a joule is a unit denoting quantity of energy) of energy has to be irradiated on the fuel capsule in order to incite the nuclear fusion reaction. The "Gekko II," which can make a hole through a copper sheet instantaneously, operates a laser beam only on the order of 100 joules. A laser with roughly 20,000 times more power is required for nuclear fusion. To be sure, a megajoule of energy is not to be generated by a single laser beam, and a number of laser beams will be used. Even then the energy per beam will be vast. "The success of laser nuclear fusion depends on how powerful a laser can be developed." (Professor Yamanaka)

Other methods besides lasers for introducing energy can be envisioned. There are the electron beam (REB), light ion beam (LIB) such as the proton beam, and heavy ion beam (HIB) involving heavy elements of atomic weight greater than 200, such as lead or radium, which can be directed at the fuel capsule to cause instantaneous explosion and contraction. Such research is being promoted at Osaka University, Nagoya University, and the Nagaoka Institute of Technology, but the work has just begun.

"The magnetic confinement approach is probably closer to attaining the critical conditions required for nuclear fusion. On the other hand, the inertial confinement method with some luck may not be more than 2 or 3 years behind." Such is Professor Yamanaka's assessment of the present situation. There is considerable effort being directed in the United States and the Soviet Union into research and development on the inertial confinement mode. The European Alliance has also taken up research in this area, although somewhat belatedly. The fierceness of this competition on the international level is not taking a back seat to the "magnetic confinement mode."

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[Text] In November of last year the Science Council (Chairman Masao Yoshishiki) of the Ministry of Education submitted to Minister Tanaka an outline of the manner in which future nuclear fusion research should be conducted in the universities.

Disengagement From Basic Research

According to this paper, there are three main lines which nuclear fusion development should adopt: 1) Emphasis should be placed on experiments directed at the combustion of deuterium and tritium, which comprise the "fuel" and materials development for providing the necessary materials for constructing nuclear fusion reactors, including the associated engineering technology research. 2) Since it is not clearly known whether Tokamak, which is presently the mainstream of nuclear fusion research, will eventually become practical, research will be promoted on modes other than Tokamak. 3) A new research and development system will be set up which will disengage itself from the university organization of the past.

When the nuclear fusion research situation to date in the universities is reviewed, it may be said that there has been no departure from basic research on plasmas. The "proposal" places emphasis on the "nuclear fusion reactor," and seeks to redirect research and development in this direction.

"We can say for certain that nuclear fusion development presently is undergoing a major change." This statement is attributed to Director Hidetake Kakihana of the Nagoya University Plasma Laboratory. The question of whether nuclear fusion will become practical has gone past the misty stage. Plasma temperatures of 80 million degrees have been attained with the PLT facility of the United States, while plasma densities of the order required to sustain nuclear fusion have been demonstrated with the Alcator A facility, also in the United States. In this manner, data which provide optimistic assessments of the future of fusion energy are being collected one after the other.

These results are the basis upon which work is under way on the "TFTR" (USA), "T-15" (Soviet Union), "JET" (European Alliance), and "JT-60" (Japan) in an attempt to attain critical plasma conditions between 1982 and 1984. Nuclear fusion is at the stage where "we will be able to demonstrate that nuclear fusion can be achieved by human hands in a scientific manner" (according to Kenzo Yamamoto, permanent adviser to the Japan Atomic Industrial Forum), while "we now expect some spectacular advances in research on nuclear fusion reactor engineering" (Director Kakihana).

Revise the Long-Term Strategy

The Atomic Energy Committee-Nuclear Fusion Council, which is the "General Staff Office" where nuclear fusion research in Japan is concerned (Chairman of the Board Tatsuaki Miyajima, Atomic Energy Commissioner), has reacted sharply to this situation. It held a "subsection review of long-term strategy on nuclear fusion reactor development" in February of last year and initiated a basic reassessment of the long-term strategy which had been established in April 1978.

According to the long-term strategy set up in 1978, following operation of "JT-60," the first step prior to construction of a fusion reactor will be the construction of a "reactor core engineering test facility" during the first half of the 1985 decade (1985-) followed by construction of a 300,000-800,000 kW experimental reactor during the latter half of the 1985 decade (1990-). This will be followed by a prototype reactor (first half of the 1995 decade (1995-)) and an experimental reactor (first half of the 2005 decade = 2000-) before the advent of a commercial reactor.

The most recent developments in nuclear fusion research have necessitated major changes. "At the very least, the reactor core engineering test facility is superfluous, and this project will probably be absorbed by the experimental reactor." This statement was made by a party close to the Nuclear Fusion Council.

In addition, study on the "INTOR Plan" to be constructed by the International Atomic Energy Authority (IAEA), with participation by Japan, the United States, Europe, and the Soviet Union, is progressing. It is possible that the progress of this plan may direct nuclear fusion research in this country toward a prototype reactor. What new directions will be taken will be resolved in the new long-term strategy plan to be drawn up this February.

Integrate University Organizations

On the other side of the picture, what are the developmental systems which sustain the developmental strategy for nuclear fusion?

Nuclear fusion development in Japan is based on the two main pillars of the Japan Atomic Energy Research Institute [JAERI] and the universities. JAERI has dedicated itself to the development of a Tokamak-type facility, which is presently considered most promising as is attested by the construction of "JT-60." On the other hand, the universities have been concerned with studies on the basic

properties of plasma and on research on more advantageous fusion modes other than Tokamak for future applications. "They have mutually supported and augmented each other and have come this far just like the two wheels on a vehicle. This setup will probably continue and needs to be reinforced. A vehicle will not move properly if just one wheel is operating normally." This statement was made by permanent adviser Yamamoto to the Japan Atomic Industrial Forum; until very recently he had been engaged in nuclear fusion research at JAERI.

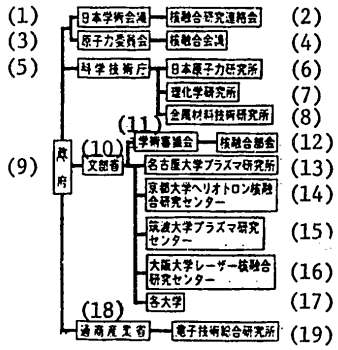
On the other hand, the universities say: "There are too many chiefs and not enough Indians, and the work is not being accomplished." This attitude may be understandable on the part of the universities, where academic freedom is a basic tenet.

In another direction, the cost of constructing these facilities is gradually increasing. The "Gamma 10" mirror facility, whose construction was started at the end of last year at Tsukuba University, was funded for about 6.2 billion yen. The "Heliotron E," completed last spring at Kyoto University, cost 9.1 billion yen. This is equivalent to the total budget for a medium-size university. Koji Fushimi, head of the Japan Science Council and a protagonist of nuclear fusion research, said: "As the necessary funds become astronomical, academic freedom cannot be the only yardstick in determining what research needs to be done. There is no other course but to conduct organized and planned research." In this manner, he indicated the need to integrate and reorganize the research setup at the universities.

The Science Council "proposal" also follows this line of thought. It specifically proposes the abolishing of plasma research at Nagoya University and the establishment of a "Nuclear Fusion Science and Engineering Laboratory" (provisional name), which will be a joint utilization laboratory under the direct control of the Ministry of Education and will incorporate the present nuclear fusion research facilities at Nagoya University into this laboratory. This new organ will be Japan's one other nuclear fusion research facility, which will function together with JAERI to further nuclear fusion, pulling together like the wheels of a vehicle.

"Among the countries of the world, Japan is the one country which will be beset the most with the problem of assuring an energy supply in the future, and nuclear fusion is one solution to the problem. We must cast aside minor differences and work for the general good." This was from Director Kakihana of the Nagoya Plasma Institute.

Japan's Nuclear Fusion Development Organization (Outline)



Key:

1. Japan Science Council
2. Nuclear Fusion Research Alliance
3. Atomic Energy Commission
4. Nuclear Fusion Council
5. Science and Technology Agency
6. Japan Atomic Energy Research Institute
7. Physical and Chemical Research Institute
8. National Metals Research Institute
9. Government
10. Ministry of Education
11. Science Council
12. Nuclear Fusion Subsection
13. Nagoya University Plasma Laboratory
14. Kyoto University Heliotron Nuclear Fusion Research Center
15. Tsukuba University Plasma Research Center
16. Osaka University Laser Nuclear Fusion Research Center
17. Various universities
18. Ministry of International Trade and Industry
19. Electrotechnical Laboratory

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[Text] "The development of independent new energy is the urgent business at hand for Japan to survive from here on. In this sense, it may be stated that nuclear fusion development will determine Japan's fate. We have now come to a stage in which the industrial world and the universities must unite as one body to achieve the targeted objectives."

These were the words of Minister of Education Takio Tanaka when he addressed the first "Industry-Academia Cooperation Roundtable" related to nuclear fusion development on 9 December of last year.

Search for Industry-Academia Cooperation

Nuclear fusion development is now about to take a new step from the basic development stage to the engineering development stage. The object of this roundtable sponsored by the Ministry of Education was to find the "road" by which the industrial world and the universities can join forces to become a single entity to conduct nuclear fusion development at this new stage.

The attendees all seemed to show lukewarm interest. The government spokesmen were Minister Tanaka and the director general of the Prime Minister's Office, Taro Nakayama. The industrial world was represented by Toshio Doko, who is honorary chairman of the Federation of Economic Organizations, along with Isamu Yamanaka, Vice President Hiroyoshi Yoshiyama, and Shoichi Sanami, all of the federation, President Takaharu Moriya of Tokyo Shibaura Electric, and the president of Mitsubishi Heavy Industries who were part of the 10 men representing industry. The university representatives included Masao Yoshishiki, chairman of the Science Council, President Takashi Mukaibo of the University of Tokyo, and President Yuichi Yamamura of Osaka University, and the directors of the various nuclear fusion research centers at different universities, for a total of 13 members. It is not exaggerating a bit to say that the elite of the nuclear fusion research brains were present. On this occasion, it was said: "If the government, private industry, and the academic world pull together as one to promote development, Japan should be able to rise to the top of the world in the matter of nuclear fusion development." This was one of the buoyant expressions which were heard.

A proposal for "Japan-USA nuclear fusion research cooperation" was submitted at this roundtable. Among those present was former Prime Minister Takeo Fukuda, who is very enthusiastic about nuclear fusion development, and he jumped onto the platform to state, in a very impassioned plea: "Unless we develop new energy such as nuclear fusion and resolve the energy shortage situation for the future, there will be the problem of uncertain world peace."

Have Confidence in One's Design and Production

"The industrial world has finally developed into a single pillar to support nuclear fusion development. That is the feeling I get," said Kenzo Yamamoto, permanent adviser to the Japan Atomic Industrial Forum.

It has been more than 25 years since research and development on nuclear fusion was initiated. During this period the industrial world was hidden in the shadows of JAERI and the various universities and did not catch the public eye, but with the cries for "industry-academia cooperation," the activities of the industrial world suddenly became active.

For example, integrated electrical manufacturers such as Hitachi Limited and Tokyo Shibaura Electric took the opportunity presented by participation in the "JT-60" development project of JAERI to gradually build up their intracompany organizations with regard to nuclear fusion development. At the same time, Mitsubishi Electric strengthened its ties with the Mitsubishi group companies

such as Mitsubishi Heavy Industries and Mitsubishi Atomic Power Industry in order to be prepared for the coming participation in the nuclear field.

"The knowledge and technology in the hands of the manufacturers were indispensable to research thus far centered on plasma physics, but when the emphasis was switched to engineering, this capability of the manufacturers became even more important in the area of nuclear fusion research." (The above was attributed to Tatsuro Omura, technical director of the Nuclear Power Industry Headquarters, Tokyo Shibaura Electric.)

"In the past we manufactured nuclear fusion experimental equipment in compliance with the needs of the experimenters. Now the situation has changed, in that we have assumed the leadership in the matter of design and manufacture of equipment." This was the statement of Shoichi Terazawa, assistant chief of the Nuclear Power Industry Division, Hitachi Limited.

Many others in charge of the frontlines of nuclear fusion development echo the same thoughts.

Now, other companies such as Kawasaki Heavy Industries, Fuji Electric, and Sumitomo Electric Industry have started vigorous programs in the nuclear industry area, as though following in the footsteps of Hitachi Limited, Tokyo Shibaura Electric, and Mitsubishi Electric. "Should the conditions for criticality be realized with the 'JT-60,' the number of participating industries will increase even more, and competition will become something fierce." (This was stated by Sadao Miyauchi, director of the Nuclear Energy Development Department, Mitsubishi Electric.)

It is expected that steelmakers who handle materials to be used in the construction of nuclear fusion reactors, manufacturers of laser equipment for providing such laser equipment to be used in "inertial confinement of plasma," and various other companies which presently have not made their appearance are expected to make themselves heard as well.

"On the other hand," says Yamamoto, adviser to the Atomic Industrial Forum, "now that the expectations of the industrial world's participation are heightened, it is just the time for the industrial world to revise its thinking on what it intends to do."

"In order for a large technological development such as nuclear fusion to be developed by our own strength without being dependent on foreign countries, there will be too many problems if each industry goes its own merry way. It is necessary to undertake cooperative development of common basic technology. This involves not only having the voice of the industrial world heeded by government but, conversely, the receipt of government's voice by industry."

Strategy Polished by Technological Discussions

The "Nuclear Fusion Technology Roundtable" was convened last December under the leadership of Mr Yamamoto. The members who participated in this discussion were

representative of industry such as Hitachi, Toshiba, Mitsubishi Heavy Industries, Sumitomo Nuclear Power, Fuji Electric, Kobe Steel, and Tokyo Electric, along with research and development members such as JAERI, the Power Reactor and Nuclear Fuel Development Corporation, Tokyo University, and Osaka University. It was proposed that this group meet once a week in order to hone its nuclear fusion development strategy.

"Nuclear fusion is right now at the budding stage as far as industrial technology is concerned, and it has to be nurtured carefully from here on. We must avoid awkward repetitions in nuclear power development," said Mr Yamamoto. The industrial world has picked up this "bluebird" known as nuclear fusion and is planning to involve itself.

[9 Jan 81 p 14]

[Text] "Will nuclear fusion pay? The situation now certainly does not point that way. In fact, there seem to be more dropouts. Some are buying in areas other than the industrial end, and this is the situation today." (This statement was made by Shoichi Terazawa, assistant of the Nuclear Power Industry Department, Hitachi Limited.)

"Nuclear fusion business is still not on the scene. Nuclear fusion development cannot be figured up on a calculator. National policy abetted by all-out cooperation on the part of industry--this is the spirit by which we are operating. To be sure, we try to minimize our losses." (Tatsuro Omura, technical director of Nuclear Power Industry Headquarters, Tokyo Shibaura Electric.)

The Goal Is a Mountain of Trophies

Where nuclear fusion is concerned, what one hears from the industrial world is not very encouraging. The country's outlay for nuclear fusion development is 36 billion yen per year (1980). What actually is passed around to the manufacturers must be considerably less. This may not be too enticing a market for manufacturers who have to maintain an intracompany organization and a large specialty staff.

On the other hand, contrary to such statements, the participation of companies such as Hitachi, Toshiba, Kawasaka Heavy Industries, and Sumitomo group companies in nuclear fusion is something to behold. The competition for orders along the line of large experimental equipment is developing into quite a struggle.

There has also begun to appear the thinking that there should be independent development rather than reliance on JAERI and the universities where matters of technological development are concerned. The Tokamak-type facility which Hitachi Limited established at its Energy Research Center (Hitachi City, Ibaraki Prefecture) to conduct plasma research in January of last year may be one such example. This is a small facility in which the diameter of the doughnut-shaped vacuum container which confines the plasma is only 71 cm, but "there are a number of technologies which can be developed through actual handling of the equipment by one's self, and many of the ideas come forth when the equipment is being supplied

to the user" (according to Masashi Nishi, principal investigator, Energy Laboratory). The effort to develop all of its nuclear fusion technology by itself is evident.

In back of this type of movement is the feeling that "even if we should presently operate in the red, nuclear fusion has the potential to become a giant industry in the future" (Sadao Miyauchi, director of the Nuclear Energy Development Department, Mitsubishi Electric). On the other hand, it may be 30 or 40 years in the future when the expected situation will materialize. This may seem akin to a long-winded marathon, but the rewards once the goal is attained are tremendous. "The race has just started, and a lot of capital will be needed to attain the goal" (same source).

Opportunities for Challenges Emerge

Now, the rewards are not limited to the tangibles. There is some collateral in undefined form.

Nuclear fusion, which contains the "solar fire," has often been tabbed the ogre of extreme technology. The present situation is that the best in the areas of materials, production technology, and control technology has to be implemented to this end. "We will pursue the limits of technology. The spinoff effect which will result is immeasurable. In one sense, it may rival the U.S. Apollo Plan which sent man to the moon" (Tetsuya Morikawa, assistant director of the Nuclear Energy Development Department, Mitsubishi Electric). This is the type of charm that the development of nuclear fusion has for some facets of the industrial world.

Take, for example, the "JT-60" which Hitachi presently is constructing for JAERI. The doughnut-shaped plasma-enclosing container which is the core of this facility has a diameter of 6 meters, and the cross-section of the flattened spherical doughnut has a diameter of 1.9 meters which is formed from 6.5-mm-thick nickel family alloy plate. The main body of the container consists of four sections which are welded together at the final stage to complete the doughnut-shaped affair.

In the production of this facility, Hitachi used an electron beam considered to deliver the largest possible output in the Orient to weld the entire container at a single stroke. There was no previous example in which this new electron-beam welding technology had been used on such a large welding project. "Nuclear fusion development offered us the opportunity to meet this challenge. I believe that this technology will blossom forth hereafter whenever large structural items are fabricated" (Vice President Terazawa).

Tops in the World Where the Industrial World Is Concerned

All the countries including Japan, the United States, and the European countries started essentially at the same time from a zero level where nuclear fusion development was concerned. This is not something that Japan took over from some other country, and it may be said that it became a project only after Japan had

become involved in its own independent technological development. The following comment on this technology was provided by Professor Mitsuo Takao, director of the Heliotron Nuclear Fusion Research Center, Kyoto University: "The level of the industrial world in Japan is, without exaggeration, on a par with the best in the world." While they say that they "are not making any money," each industry has been accumulating nuclear fusion technology for about 20 years. They hope that this accumulation will now begin slowly to pay off.

Foreign evaluation is also good. During the construction of the American "TFTR," which corresponds to our "JT-60," there was an inquiry on fabrication directed to a certain Japanese electrical maker. It is said that there are many more parts of American nuclear fusion experimental facilities today which are of Japanese origin. "We must not think only in terms of domestic needs but from here on think on an international development level," said Yukiharu Sakamoto (director of the Nuclear Fusion Development Department, Toshiba).

Last June, the Nuclear Fusion Review Subsection of the Energy Research Inquiry Committee of the U.S. Energy Department released a single recommendation. It was named the "Booksbaum Report" after the name of the party drafting the recommendation, and it stated: "Nuclear fusion is now entering the engineering research stage, and there is need from here on for the industrial world to participate as the central figure in the developmental plan." This reveals the American industry's negative attitude toward nuclear fusion development which the report hoped to overcome.

[13 Jan 81 p 13]

[Text] The first barrier to the attainment of nuclear fusion, the breakthrough to critical plasma conditions, is almost at hand. On the other hand, a number of problems remain to be resolved before the "fire" of nuclear fusion is finally at hand. How shall we accomplish this? We will examine a number of important technologies which will determine the fate of this course.

When the "magnetic field confinement method" is employed, the plasma is contained within a strong magnetic field in a stable manner and also is heated to a very high temperature on the order of 100 million degrees. That is to say, the nuclear fusion "fire" cannot be lit unless this temperature level is attained. How do we generate such a high temperature? In this manner, the first key to the success of nuclear fusion is the heating technology.

Tokamak represents the most advanced model at the present time. Here, a number of heating modes can be used together.

In the Tokamak type of facility, the plasma is confined within the doughnut-shaped container by the magnetic field provided by magnets deployed along the container (toroidal magnetic field) and the magnetic field created by the passage of a strong electric current (plasma current) through the plasma (poloidal magnetic field). The current passed through the plasma to generate this poloidal magnetic field also serves to heat the plasma.

Limit to Joule Heating

When an electric current is passed through nichrome wire with its high resistance, heat is generated. Electric heaters utilize this property, and the plasma enclosed within a magnetic field plays the same role as that of the nichrome wire. When a very large electric current is passed, the nuclear fusion facility is converted to a giant electric heater to generate heat and raise the temperature of the plasma.

This method of heating is called Joule heating. What is bothersome here is that the plasma resistance decreases with rising temperature, and there is a temperature plateau beyond which this type of heating becomes ineffective. It is said that the upper limit of Joule heating is about 20-30 million degrees. This level of heat is insufficient to light the nuclear fusion "fire." A second mode of heating to supplement this Joule heat is necessary.

The secondary heating methods presently considered promising are the neutral particles injection method and high-frequency heating.

In the neutral particle injection heating method, neutral particles such as hydrogen or deuterium are formed into high-energy beams and injected into the plasma. These neutral particles pass through the magnetic field undeterred and enter the plasma. In this manner, the energy contained in these neutral particles is added to the plasma, and the temperature rises. This can be likened to the addition of steaming water (neutral particles) to lukewarm plasma to raise the temperature of the hot water. The large Tokamak facility PLT at Princeton University in the United States employs this neutral particle injection method to create high-temperature plasma of about 80 million degrees, thereby providing a very close approach to critical conditions.

The high-frequency heating method uses externally generated electromagnetic waves to heat the plasma. The particles in the plasma, such as electrons and ions, undergo what is called cyclotron movement and rotate in an orbit at some fixed period. When electromagnetic radiation of the same period and frequency as the cyclotron movement is applied from the outside, the particles in the plasma absorb the energy in these electromagnetic waves and the temperature rises.

This is very similar in principle to an electric range. The high frequency employed is adjusted to the rotational period of the ions and electrons, and the frequency can be varied between 10-100 megaHertz, the frequency range used in FM broadcasting, to 30-60 gigaHertz, which is the frequency of space communications. The practical use of this high-frequency heating has been demonstrated over the past couple of years in various countries.

Joint Use for the Present

It is not possible at this present stage to decide which of the two--neutral particle injection or high-frequency heating--will be the second heating stage. This is the consensus among the nuclear fusion researchers. The feeling is that both will be used for a while. The "JT-60" presently under construction will

use this dual mode, and it is hoped to attain the targeted temperature of 100 million degrees.

"When we think of the future, there may be some advantage in high-frequency heating." This was the estimate of Yuji Tanaka, director of the Plasma Experimental Laboratory of the Nuclear Fusion Research Department, JAERI.

Heating facilities with very large output are required in an actual nuclear fusion reactor, and the neutral particle injection facility (NBI) begins to suffer as larger outputs are required and the efficiency of generating neutral beam falls off at higher output.

Each NBI unit used in "JT-60" has an output of about 1.4 megawatts. Its efficiency is about 40 percent. Where a nuclear fusion reactor is involved, the output per unit needs to be several times the above value, but such a unit will suffer decreased efficiency to about 10 percent. Poor efficiency means greater electric consumption. The efficiency of the NBI must be raised to at least 50 percent to operate a reactor in an economical manner. "Some means to improve efficiency, such as installing energy recovery systems, must be introduced" (Yukiji Sakamoto, head of the Nuclear Fusion Development Department, Tokyo Shibaura Electric). The goals of this technology have not yet been established.

Development Fever in the Western Countries

There are fewer such difficulties associated with high-frequency heating. Furthermore, research at JAERI has shown that the application of high frequencies to plasma will not only heat the plasma but simultaneously stabilize the plasma current and enable the reactor to operate at good efficiency. The United States, the Soviet Union, and the various European countries have begun to put great effort into the development of high-frequency heating devices.

Communication broadcast equipment technology is the base for development of high-frequency heating equipment. Will Japan, with its high technology in this area, be able to keep up with the other countries in this development? Development of high-frequency generators of large output has been started at JAERI and companies such as Toshiba and Nippon Electric.

A powerful second heating stage facility is required not only for a Tokamak-type facility but for the mirror method, Heliotron method, and any other magnetic confinement method. There must be a consensus in the "common primary test" called heating technology in order that nuclear fusion reactors can be constructed.

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[Text] Mountain peaks soaring, as though to keep people away. The peak in mind looms mistily in the distance. A quick look at nuclear fusion reactor material development may seem that way The mountain climber is the material researcher. "And we are now only at the foothills," said principal researcher Ryuji Nagasaki of the Fuel Engineering Department of JAERI. If we are to scale this peak known as nuclear fusion reactor materials, it will come only after we have climbed a number of peaks along the way.

When selecting materials to fabricate products, studies are made from various angles--for example, does the material in question have sufficient strength, can it withstand heat or chemical attack, or is it easy to finish? The materials which make up the nuclear fusion reactor, particularly the metals used to manufacture the vacuum container that holds the plasma, not only must be examined from such viewpoints but from even more severe conditions as well.

The vacuum container of a nuclear fusion reactor receives high-temperature heat from the plasma, is heated to 300-500°C, and is further subjected to radiation by high-energy helium and neutrons. This helium and these neutrons are the culprits that cause the material to sputter (note), blister (note), or swell (volume expansion), as a result of which the material itself can become brittle and no longer be able to function as container material.

Neutron Irradiation Is the Problem

The "JT-60" presently under construction is intended only to attain the conditions for making critical plasma and is not planned to contain a nuclear fusion reaction. As a result, the neutron irradiation problem will not arise. Material already available that can withstand the conditions will suffice. Now, the next reactor, which will be an experimental reactor in which a nuclear fusion reaction will be conducted, will face with this problem.

As far as high temperature and neutron irradiation are concerned, the materials to be used in the fast breeder reactor and the high-temperature gas-cooled reactor presently under development will be subjected to the same conditions. Can the materials used in these reactors be used in the fusion reactor? "While it is not impossible, it does not seem that such materials can be used directly," according to Assistant Director Yoshikazu Hamaguchi of the Physics Department at JAERI. "Not only the temperature but the energy associated with the neutrons will be orders of magnitude larger."

The neutron energy of the materials at the central section of the fast breeder reactor is of the order of 1-2 million eV, while in comparison this energy is one order of magnitude larger in the case of a fusion reactor, or about 14 million eV--thus the greater level of damage which can result.

In addition, the parts of the fast breeder reactor which receive this high temperature and neutron irradiation are the fuel cladding tubes. In the case of the fusion reactor, it is the main body of the reactor itself which is subjected to harsh conditions. It cannot be replaced immediately once it becomes brittle, as is the case with the fuel rods. The fusion reactor container must be able to last for at least 10 years. "Because the materials have to be exposed to various kinds of harsh conditions, the development of nuclear fusion reactor materials constitute probably the greatest challenge to the nuclear researcher" (Assistant Director Hamaguchi).

There Are No Test Facilities

Another factor which complicates the development of fusion reactor materials is the lack of a means to test and evaluate the prospective materials. The best

means for testing any material which has been developed for use in a fusion reactor is to place the material in a fusion reactor. There is a materials testing reactor for the development of nuclear fission reactor materials, and its value has been well demonstrated; there is no such facility for fusion reactor materials. The only recourse is to approximate the high temperature and irradiation from neutrons and other sources with a fast breeder reactor, hot neutron reactor, and heavy ion accelerator, and then to assemble the data for evaluation and projection. Since all these conditions apply simultaneously when a fusion reactor is operated, there is no way of predicting what will happen.

Recently, a test facility has appeared for testing the most important effect brought about by neutrons. An accelerator is used to irradiate material test pieces directly with 14 million eV fast neutrons and thereby mimic the effect of neutron irradiation. The "FMIT," construction of which was started last year in the United States, is one such representative. Construction of this FMIT will cost $105 million (about 30 billion yen). The United States is asking Japan to put up a billion yen as its share for cooperative use.

Principal Researcher Nagasaki says: "It will be possible to obtain a certain measure of performance through the use of FMIT." On the other hand, the size of the material test pieces which can be placed in this facility is limited to the size of a needle. Such being the case, there is a problem as to whether the data obtained can be directly extrapolated to very large equipment. "Material development presently will be in the groping stage" (Principal Investigator Nagasaki).

"It takes a minimum of 10 years to develop new materials. Development of materials for a fusion reactor may take even longer." This was the statement by Department Head Heitaro Yoshida of the Nuclear Reactor Materials Research Department of the Metal Materials Technology Laboratory, Science and Technology Agency.

Now, the country's nuclear fusion development plan proposes the design and construction of an experimental facility to create nuclear fusion reactions 4 years from now, in about 1985. Will the materials be ready? "At the present time, the only pathway is to improve materials which may possibly fulfill the requirements" (Department Head Yoshida).

Research Committee Started Last Year

The material which seems to be usable at the present time is an austenite stainless steel called SUS 316. "Since we can make the allowance that the material end will be the limiting factor to performance in the initial experimental class reactor, it may be possible to use a modified SUS 316. The development of material suitable for a commercial reactor will be under way in the meantime. That is the strategy." (Assistant Director Hamaguchi of JAERI). In other words, it is planned to buy time by using the improved SUS 316 for the time being while some material highly resistant to heat and neutrons such as an iron-nickel-chromium family alloy, molybdenum alloy, or niobium alloy type high melting point material is developed.

A research committee for nuclear fusion materials comprised of researchers centered on JAERI, the universities, and various steelmakers was started last year to engage in the development of these materials. At the same time, research on coatings consisting of titanium carbide or silicon carbide on the inner wall of the vacuum container which can be applied without lowering the plasma temperature, as well as research on material testing, is under way at the Metals Research Institute. "Development of fusion reactors may be delayed considerably, depending on the progress in material development" (Assistant Director Yoshida, Metals Research Institute). We must not stop in this approach to the targeted peak.

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[Text] The difference between the energy required to contain plasma and the energy from a nuclear fusion reaction is the output of a nuclear fusion reactor which is withdrawn and utilized. The higher this output ratio, the better the economic aspects of the reactor.

When a magnetic containment method is employed, most of the energy is consumed by the electromagnet section. A number of giant magnets are required to contain the high temperature and density plasma with a strong magnetic field. Should magnets wound with copper wires be used in this application, as is the present practice, tremendous power will be consumed. The resistance offered by these copper wires will result in the greater part of the electric power being lost as heat. The power required to generate the magnetic field for the "JT-60" presently under construction is said to be from 200,000 to 300,000 kW. This is the power used by a city of 500,000 people.

If the experimental reactor and the commercial reactors which follow should use magnets wound with copper wire, a 1 or 2 million kW class powerplant would be required to operate these reactors. Such a situation would upset the energy balance, and the fusion reactor would become useless as an energy source. The solution to this problem is the superconducting magnet (note) which cuts down the power consumption by several stages. There are some calculations which claim that the power required for plasma containment can be reduced to 1/100 or less.

Top Level in the World

"Japan's superconducting magnet development ranks with the best in the world," said Director Yukuo Kobata of the Nuclear Fusion Research Department, JAERI.

The cluster test coil developed at JAERI last year is a good example which demonstrates its "practicality." The 1.5-meter-diameter superconducting magnet with the shape of a partially removed toroidal coil of a Tokamak facility generates a magnetic field of six tesla (note) maximum. With the exception of the four tesla output magnets of the Soviet Tokamak-type research facility "T-7," this magnet represents the tops in the world for nuclear fusion use.

We now look at poloidal coils, which present greater difficulties than toroidal coils. These coils are used to pass electric current through the plasma, and

they must generate or remove the magnetic field in a short period of time. There is a possibility that the superconducting state may be destroyed as a result. The manner in which such behavior is suppressed offers a challenge to the innovator. The Electrical Industry's research team last year developed a superconducting magnet which can generate three tesla magnetic field in the short space of 5 seconds. "We are somewhat behind, compared to the United States, but we seem to be on the right track in attaining the goal of creating a large magnetic field in 1 second," said Principal Researcher Toshitada Onishi of the Energy Department of the Electrotechnical Laboratory.

Practical Use in Magnetic Levitation Train

The magnetic levitation train operated by the National Railway has achieved speeds of better than 500 km/hr. This is a tribute to the feats of Japanese research capability, which can produce first-class superconducting magnets for practical application. The development of superconducting materials to replace copper conductors, which is being carried on at the Agency of Science and Technology and the National Metals Research Institute, has produced results which are well recognized around the world.

In addition, "superconducting technology with its wide range of applications in storage and transport will be a basic technology for electrical manufacturers from here on" (Sadao Miyauchi, director of the Nuclear Energy Development Department, Mitsubishi Electric), and there are high hopes on the part of industry.

On the other hand, there are statements such as: "Optimism should be avoided. There are many unseen pitfalls." Such remarks are credited to Susumu Shimamoto, head of the Superconducting Magnet Research Section, Nuclear Fusion Research Department, JAERI.

To be used in nuclear fusion reactors, superconducting magnets must not only put out large magnetic fields but also be very large. When an electromagnet operates, not only is a magnetic field created but the magnet develops a force to bulge outward. As electromagnets become larger, this force increases in geometric proportions.

Superconducting magnets of giant size with diameters as large as 10 meters are required for practical scale nuclear fusion reactors. When such large magnets operate, the forces applied on the magnets will probably be so large as to exceed one's normal thoughts. The structural materials which support these forces (core) must be of a considerably rugged nature. One wonders whether there is any material that can withstand the very low temperature of about -270°C for over 10 years without deteriorating.

Last spring, a professor from the University of California in the United States who had been researching superconducting magnets visited Japan. He said to a Japanese specialist, "I hear that a Japanese steelmaker has started development of a manganese family of specialty steels. I believe this type of material is optimum for very large superconducting magnets, but can you supply me with the details?"

The Japanese specialist, whose attention had been completely captured only by the glamorous front of the development of superconducting materials, was stuck for an answer. The United States had struck on an important point to be considered in the future and had spread its network of inquiry as far as Japan.

Unpredictable Pitfalls

"Unless we do not let ourselves be carried away by the glamorous facade and thereby direct all our attention in that direction, but also put efforts into the development of structural materials, studies on the deterioration of materials at very low temperature, and freeze technology of high reliability which are somewhat hidden below the surface, an unbalanced technology development will result and we will surely fail somewhere," said Section Chief Shimamoto.

At about the start of the 1950's, the British jet plane Comet made a glamorous appearance on the travel scene, but it suffered many accidents. These failures were not due to the jet plane's heart, the jet engine. The failures were due to the lack of materials development, and the sections where the wings were mounted failed quite frequently. Thus there are unexpected pitfalls that await any new technology. Superconducting technology, which is an indispensable adjunct to the nuclear fusion reactor, must be examined carefully for such pitfalls.

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[Text] Will nuclear fusion using lasers be possible? The "Kinko Plan," aimed at the scientific demonstration of such a possibility, has recently been initiated at the Osaka University Laser Nuclear Fusion Research Center. This is an enthusiastic plan which is planned to demonstrate through a program planned for 10 years that a "breakeven" point can be attained between the energy put in by laser and the energy put out by the nuclear fusion reaction that is initiated. The first half of this program, which will end in 1984, will involve construction of the large output glass laser called "Gekko XII" at a cost of about 12 billion yen; with it the nuclear fusion explosive-contractive tests will be conducted which will be a preliminary to the breakeven demonstration.

"Gekko XII" is a large glass laser whose length exceeds 20 meters, and 12 such units will be needed. The light from these 12 lasers will be directed at a roughly 1 millimeter diameter fuel capsule where the explosive-contractive process will take place and instantaneously start the fusion reaction.

Last year two large output glass lasers were constructed as test units for the "Gekko XII." The maximum output per beam is 350 joules (a joule is a unit of energy). It is said that this output is roughly three times that of the American "Shiva," which has been rated the most powerful in the world to date.

The breakeven point is the so-called critical state for laser nuclear fusion. It has been roughly 10 years since development was initiated. "The results have now placed us within firing range of our objective," said Professor Chiyobei Yamanaka, director of the Nuclear Fusion Research Center, as he projected the future.

Reactor Is of Simple Construction

The construction of a reactor using lasers to carry out "inertially confined" nuclear fusion is simple, the reactor is small, there are few technological obstacles which stand in the way of reactor construction, and there are many advantageous features compared to the "magnetic confinement mode." On the other hand, there are problems which are not encountered by the "magnetic confinement method."

The biggest problem is how to construct a large laser to provide the needed output. Laser nuclear fusion involves the irradiation of a fuel capsule with a vast slug of energy which causes the nuclear reaction to take place in the short time of a nanosecond (one-billionth of a second). The energy necessary to achieve this breakeven condition is about 100 kilojoules, and roughly 10 times this energy or about 1 megajoule will be required for a reactor.

At the present time, the glass laser is the only laser which can put out such a large amount of energy. The total output for the "Gekko XII" now under construction at Osaka University is 20 kilojoules. This total must be increased five times to come to the breakeven point. Either increasing the output per beam by a slight quantity or increasing the number of beams may make the goal of 100 kilojoules attainable.

The Lawrence Livermore Laboratory in the United States has started on a program to construct the large-output glass laser "Nova" by 1984. This structure will consist of 40 glass lasers, and the beams from these units will be concentrated on the fuel capsule and achieve the breakeven state.

To be sure, "it may be possible to attain this breakeven point with glass lasers. On the other hand, it may be that the glass laser will be no longer usable in the next stage of the nuclear fusion reactor." This was the statement of Masaaki Yano, director of the High Temperature Technology Research Section, Electrotechnical Laboratory, Industrial Science and Technology Agency.

"Glass" Has Its Defects

The limiting factor in the use of a glass laser is its very poor efficiency of less than 1 percent. With this low efficiency, enormous power will be required to generate the laser beam just to achieve the breakeven point, and operating a fusion process with this setup will result in a large negative power balance.

At the same time, the "glass" which is the heart of the laser will be heated to a high temperature in the course of 1 nanosecond each time the laser is pulsed, but it requires 15-30 minutes to cool down, making it impossible to trigger the next laser beam during this cooling period. At the same time, this retention of heat makes it impossible to prevent deterioration to the glass itself. No matter which way one looks, the glass laser does not seem to fit the bill in its application to a fusion reactor. "When considered from the standpoint of high efficiency, repeated oscillation capability, and resistance to the laser beam, the gas laser seems to be the most advantageous for practical use" (Section Head Yano), according to present estimates.

Among the array of gas lasers, the one which seems to offer the best potential for use in fusion reactors is the CO_2 gas laser. This laser can be operated at 5 percent efficiency in the pulse oscillation generation necessary to nuclear fusion, and research on producing large-output lasers of this type is under way. "Rekko III," a CO_2 gas laser with total energy of 10 kilojoules, has been developed at the Osaka University Laser Nuclear Fusion Research Center, and tests will be initiated soon.

It is said that "depending on the progress in development, attainment of the breakeven point by use of the CO_2 laser is possible" (Professor Yamanaka). Parallel with the construction of the "Nova" glass laser in the United States, construction of the "Antares" CO_2 gas laser is under way at the Los Alamos Laboratory which is to be used to attempt to reach the breakeven point. This facility is expected to be completed in 1985.

There are also some shortcomings to this CO_2 gas laser. One is its wavelength of 10.6 μm, which is considerably longer than that of the glass laser (1.06 μm). "In general, the shorter the wavelength of the laser beam, the better the chance of an explosive-contractive nuclear fusion process" (Section Head Yano), and this is the sore point where the CO_2 gas laser is concerned.

Because of this situation, "there is a need to develop a third large-output laser to follow the glass laser and the CO_2 gas laser if we are to succeed in nuclear fusion" (Professor Hiroshi Takuma of the Electrical Communications University). This is representative of some of the sentiments heard. Some probable candidates are the excimer to utilize the energy generated when a dilute gas such as krypton fluoride or hydrogen fluoride is excited, the free electron laser in which accelerated electrons are acted on by a magnetic field to cause laser oscillation, and the iodine laser. Research and development has just started on these lasers, and any contribution to the total effort will have to come later.

Large Spinoff Effect

Professor Yamanaka states: "Laser nuclear fusion development will not proceed unless high-level industrial technology is available." This is a point at which Japan, with its advanced electronic technology, should be in a good situation.

In addition, the Hodogaya Glass Company developed a high-performance glass for laser use which is being used in "Gekko XII" and the American "Shiva" and "Nova," and the peripheral technological level is also high. "The technology accumulated by laser development will be useful in the opto-electronics that is forthcoming, and the spinoff effect is very large" (Professor Yamanaka). At the present time only a very few electrical manufacturers, such as Nippon Electric and Ushio Electric, have touched upon nuclear fusion development. On the other hand, those manufacturers who are looking toward the future by urging the development of the "magnetic confinement method" can be in a good position to whet their appetites on laser nuclear fusion.

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[Text] The exploration ship has been sailing the "Plasma Sea" in search of the "Treasure Island" known as nuclear fusion. At the end of a long voyage it has finally come close to its targeted island. There is, however, an obstacle which looms ahead in the form of high cliffs which rim this island. There seems to be no way one can land on this island. One can see the treasure if he can rise above the fog and mist, but unfortunately it is unassailable.

"The thing to do in such a situation is to send out some nimble character to develop a route. This is the role that we propose to assume." This was the statement from Instructor Akira Miyabara of the Nagoya University Plasma Laboratory.

Breakthrough With the Nagoya University "R Plan"

The Nagoya University "R Plan" which has appointed itself to setting up this route will start to function this year. This big project, programmed for 10 years with expenditures of close to 100 billion yen, will involve the construction of a facility roughly one-fourth the scale of the Tokamak type "JT-60" facility, which is presently being constructed by JAERI, in which deuterium (D) and tritium (T) will be burned and actually light the nuclear fusion "fire."

Once the primary barrier critical conditions are licked, combustion of the nuclear fusion fuel will actually take place and nuclear fusion studies must proceed. This stage will be beset with the emergence of various problems. Assistant Principal Investigator Tatsuzo Tonen of the Nuclear Fusion Research Department of JAERI stated: "Output control, energy conversion, fuel supply, and the removal of the helium that is left as the 'ashes' of the fire become problems. But even before all of this, the manner of controlling the changes in the plasma with the fusion reaction becomes a major problem."

The fundamental step in nuclear fusion is to tame the plasma. On the other hand, the plasma is not a still entity. It will move when the opportunity presents itself, or it can undergo changes in temperature or density distribution states.

It is necessary to control these changes in an adequate manner, but unlike the conditions for criticality, the conditions for the nuclear fusion D-T reaction are multiplied manifold in severity. This is because the effect of the helium particles produced by the nuclear fusion reaction causes instabilities in plasma temperature and confining magnetic field.

The problems accompanying this nuclear fusion reaction can be grasped to a certain degree through simulation experiments, and countermeasures can be devised. "On the other hand, what is constantly in everyone's mind is the fact that there is a limit. If one wants to know what the actual situation is, he has to experimentally test the nuclear fusion reaction," said Professor Hiromu Hyakuda of the Nagoya University Plasma Research as he discussed the intent of the "R Plan."

There are many attempts to execute the nuclear fusion reaction. The United States is constructing the "TFIR," a large Tokamak-type facility, and it plans to conduct at least 10 rounds of D-T reactions possibly by mid-1985. The European Alliance plans to build the "FET," while the Soviets are planning a similar experimental move. "INTOR," planned for completion about 1990 through international cooperation, is expected to actually engage in D-T combustion experiments. Japan will conduct combustion experiments with an experimental reactor to be built after "JT-60."

Accumulate Technology With Small Facility

On the other hand, Professor Miyabara of Nagoya University had this to say: "Nuclear fusion research to date has stopped at the so-called plasma physics region. We are now about to enter the actual nuclear fusion region accompanied by combustion. Now, the technological obstacles which will be encountered on the way will be numerous."

Professor Hyakuda added: "Some excesses will occur if there should be an abrupt use of a large facility to create a nuclear fusion reaction, and it may be dangerous. It would be more advantageous to use a comparatively small facility to accumulate sufficient technology which can then be applied to the construction of the nuclear fusion reactor." In this manner, he warned of the precautions to take before entering untrod ground. Some difficulties are quickly anticipated with the magnitude of the "TFTR" facility which the United States is going to use for D-T combustion experiments taking advantage of the momentum of having realized critical conditions. "People chasing two rabbits" is what this amounts to.

Should the "R Plan" proceed in an orderly manner, the D-T combustion experiment will be started in 1989. This experiment will be repeated some 2,000-3,000 times. "We will thoroughly examine the changes in plasma which accompany the nuclear fusion reaction" (Professor Hyakuda). These results will be the technological cornerstones when a nuclear fusion reactor is to be constructed in the future.

The item that must not be forgotten when the nuclear fusion reaction is to be started is the fuel. Seawater contains roughly 34 grams of deuterium (D) per cubic meter, and the technology to recover this deuterium is partially perfected. The problem is the other fuel component tritium (T). "The real problem is just how to assure a stable supply of tritium," said Department Head Yukuo Kobata of the Nuclear Fusion Research Department of JAERI.

Tritium is essentially not present in the natural state. Thus, when tritium is to be used in nuclear fusion reaction, the entire amount has to be manufactured. By irradiating lithium with neutrons, a considerable yield of tritium is obtained. But how do we obtain this lithium? Lithium is found distributed with greater polarization than the atomic reactor fuel uranium. It is virtually nonexistent in Japan. It is said that 1 cubic meter of seawater contains 0.17 g lithium. There has been little effort expended to recover this lithium.

A nuclear fusion reactor has a large quantity of lithium oxide mixed into the blanket which lines the inner wall surfaces; this absorbs the neutrons generated by the nuclear fusion reaction and produces tritium. In other words, the fusion reactor operates while generating its own fuel, but here again, the tritium thus produced must be separated and purified. Research is under way on a thermal diffusion method which exploits differences in diffusion rates at the high temperature of 1,000°C and on a very cold separation method in which differences in boiling point at the subzero level of minus 250°C are utilized, but the methods are a long way from becoming practical.

There Is No Facility for Large Volume Handling

The reason why development of production and separation technology for tritium is being delayed is "the complete absence of any facility to handle a large quantity of radioactive tritium" (Department Head Kobata).

Tritium production technology has a very close relationship with hydrogen bomb production. The United States and France, which possess the hydrogen bomb, have large tritium producing and storage facilities. Japan, which is a peaceful country, has no such facilities. It has to start from scratch. The handicap is great.

The D-T combustion experiment to be conducted by the "R Plan" at Nagoya University will use about 4 milligrams tritium per test. A total of 14 grams should suffice for the overall experimental program. If this were all, it could be purchased from foreign countries. On the other hand, the experimental nuclear fusion reactor will require 3-4 kilograms for the initial loading, and between 5-6 kilograms will have to be supplied during the course of a year. This supply has to be at hand if we are to resolve our energy situation. What shall we do? There is presently no facility in Japan which can produce even 1 gram of tritium per year. If left untended, this lack may prove to be the Achilles Heel of Japan's nuclear fusion development.

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[Text] At the "Eighth Plasma Physics and Controlled Nuclear Fusion Research International Conference" sponsored by the IAEA (International Atomic Energy Agency), held in Brussels, Belgium, in July of last year, a number of papers drew the attention of those in attendance. One such paper was that delivered by the staff of the Argonne National Laboratory of the United States describing their conceptual design of a nuclear fusion reactor, the "Star Fire," which was drawn up with the technical cooperation of power companies.

United States Presents New Conceptual Design

The radius of the torus (doughnut-shaped container) for the "Star Fire," which employs a Tokamak mode (magnetic confinement method), is 7 meters, and the cross-sectional radius of the plasma is 1.94 meters. The four large Tokamak-type facilities now under construction in the world, including the JAERI "JT-60," have a torus radius of about 3 meters and a plasma cross-sectional radium of

about 1 meter; thus it can be judged that this conceptual design relates to a sizable facility. It is considerably larger than the reactor INTRO which is planned to be constructed as an international project.

Ferrite steel will be used to construct the reactor's main body, and superconducting magnets will be used. The thermal energy generated by the D-T nuclear fusion reaction will be transferred to a coolant (deuterium), and steam turbines will be utilized to generate 1.6 million kW power.

Kenzo Yamamoto, permanent adviser to the Japan Atomic Industrial Forum, made the following comment on "Star Fire": "It does not simply embody the concept of a nuclear fusion reaction but it also strongly reflects the user's wishes in the event that nuclear fusion reactors become practical in the future, and this is an important feature."

Nuclear fusion development has trained its sights on the goal of "scientific demonstrations" of attainment of critical conditions and is now about to enter the "engineering demonstration" stage. Presently, the element technology vital to the construction of nuclear fusion reactors, such as reactor materials technology, superconducting technology, and production and separation of tritium to be used as fuel, is being pursued with great vigor. At the same time, the subject of "special demonstrations" must not be left out when the stage of practical use is considered.

Director Yukio Tsutsui of the Central Research Laboratory of the Electric Power Industry said: "There are several conditions that must be fulfilled before a single technological system can be accepted into society. The economic aspects, the safety aspect including the handling of the limited radioactive products, the ease of use, and reliability must be more than adequate in the case of nuclear fusion."

"Star Fire" was designed with a number of considerations directed toward these ends. That is to say, it is the trial balloon for the practical application of nuclear fusion. "To date, nuclear fusion development has been conducted without any thought of fulfilling the conditions that will have to be utilized in practical situations. From here on we must take into account all the practical points. It is not too early to follow such a line." (Adviser Yamamoto)

The Point of Economics

Among these points, one major item is economics. Should the energy produced by a nuclear fusion reactor be more expensive than energy from other energy sources such as coal or fast breeder reactor, its practical stage would be delayed that much longer.

The selection of the reactor is reflected in the economics of the situation. The most advanced development stage is associated with the Tokamak-type reactor, yet it cannot operate under steady state conditions, and the β value which is an index of plasma confinement efficiency is so small that the reactor has to be made very large. In this manner, the construction becomes complicated and even

almost impossible. These are some of the drawbacks which appear. As development progresses, these shortcomings are gradually being removed. Even when we limit ourselves to the "magnetic confinement" types, such as the mirror type, the heliotron type, or the compact and low-cost reverse magnetic field pinch type, there are a number of types with a potential for displacing Tokamak, and modes incorporating new ideas are appearing on the scene. Which is the most advantageous mode? Considerable discernment is required.

Energy balance is also one of the major problems. Vast quantities of energy are required to operate a large nuclear fusion facility. Expenditure of large quantities of electric power to incite the fusion reaction is unavoidable, no matter whether the "magnetic confinement method" or the "inertial confinement method" is employed. Unless the energy taken from the nuclear fusion reaction greatly exceeds the energy required for the reaction, "dream energy" will end up a "dream."

How shall we convert the energy generated by the nuclear fusion reaction into a usable form? The basic pattern is to absorb the neutrons generated by the D-T nuclear fusion reaction into the blanket which lines the inner walls of the reactor and convert to thermal energy, transfer this heat to water or an alkali salt, and operate a generator. This mode should be selected with maximum efficiency in mind, and many more studies are needed before that stage can be realized.

No Room for Optimism as Yet

Director Hidetake Kakihana of the Nagoya University Plasma Laboratory said: "Unless we put considerable effort into the development of this energy conversion mode, the materialization of nuclear fusion may be in jeopardy." He was thus cautioning against undue optimism about the practical use of fusion energy.

In the "Bookbaum Report" released last June in the United States, the opening section states: "The information (on nuclear fusion) presently available and the various facilities under construction are pertinent to the attainment of criticality at the core of the nuclear fusion reactor and self-lit nuclear fire conditions, but they are not at the stage where environmental safety, safety, and economic conditions are satisfied." The path to the realization of nuclear fusion is not always smooth. Conversely, only the stubbornness of nuclear fusion as it seems to resist man's knowledge stands out.

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[Text] 3 May 1978 was a day representing a great "turning point" for Japan's nuclear fusion development in a number of ways. This was the day Prime Minister (at that time) Fukuda proposed to (then) President Carter that Japan and the United States ratify an energy research and development cooperative effort centered on nuclear fusion. The contents of this proposal were extremely bold--for example, the two countries would put up a billion dollars each to construct research facilities mainly in the United States and put up funds to conduct research at these facilities.

Government to Center Stage

To the Science and Technology Agency, which had ploddingly been building plans for Japan-USA nuclear fusion cooperation for the Japanese nuclear fusion researchers, this was an extraordinary proposal which literally went over their heads. The director of the agency at that time said: "I am completely at a loss as to what this is all about."

Not only did this Fukuda proposal open the way to the massive Japan-USA research cooperation which followed, but it was also the turning point which sent the technology that was formerly in the hands of the technologists and researchers to the Foreign Service to be used to propel the government to center stage.

In the matter of property of the Foreign Service, there was one banking man's "secret maneuvers" which took place in the shadows of this proposal. There are still many people in the ranks of the nuclear fusion researchers who do not know the identity of this man. We will call him Mr A.

Mr A's testimony: At that time Japan was in a position of having a very large plus economic balance, and how to reduce this excess pile of dollars was a major problem. There was thought of purchasing airplanes from the United States and then leasing them to Southeast Asian countries. The second measure which emerged was nuclear fusion cooperative research. This measure not only would bring about a reduction of these external funds but would eventually reap profit to this country. Almost all of the American research facilities were inspected during a 21-day period, and the verdict was "good"--whereupon the word was passed on to Prime Minister Fukuda.

At that time, there was a strong feeling in the United States that "Japan was getting a free ride on technology." This proposal also served to weaken this feeling. At the same time, the opinion of government and financial circles with regard to nuclear fusion was enlightened, and the importance of nuclear fusion became understood by people other than the specialists.

The Fukuda proposal was finalized in May 1979 by the signing of the Japan-USA Energy Research and Development Cooperative Agreement by then Foreign Minister Sonoda and then Director of Energy Schlesinger. The nuclear fusion area involved utilization and improvement of the Doublet III Tokamak-type experimental facility of the General Atomics Company over a 5-year period, for which a total of 30 million yen was to be allotted (to be borne equally by the two countries).

This effort at international cooperation in nuclear fusion not only served to reduce the dollar balance but is still paying off even now for an entirely different reason. Research and development costs are assuming such astronomical proportions that it is becoming increasingly difficult for a single country to bear the costs, and this is the primary reason.

It is still not clear whether nuclear fusion will actually become the energy technology for the future. Even though nuclear fusion is still at the so-called research and development stage, the government outlay is already 35.6 billion yen

(JFY 1980), and the "Critical Plasma Test Facility (JT-60)" which is presently under construction at the Japan Atomic Energy Research Institute, and which is aimed at a scientific demonstration of nuclear fusion, is expected to cost a total of 200 billion yen (including site cost).

Spread to Many Countries

As evidenced to date, should the possibility of attaining nuclear fusion become clearer, the funds for the development of facilities, of new materials, and of tritium (hydrogen isotope used as nuclear fusion fuel) handling technology aimed at the power-generating reactor are expected to reach staggering sums which will be beyond anything that has been seen thus far.

This is why a movement has arisen in different countries to cooperate with each other to promote efficient research and development. Cooperation must take place not only at the financial end but also at the "brainpower" end; otherwise, development will not proceed.

At the present time, Japan is putting its greatest effort into this Japan-USA cooperative effort, but it is also participating in multiple country cooperation centered on the IAEA (the international energy organ).

The cooperative subjects range over a wide field. The major subjects are listed below.

IAEA: INTOR, which is an experimental reactor (international Tokamak reactor) design cooperative.

Atoms and molecules data information exchange.

IAEA: Superconducting magnet design (a total of six superconducting magnets to be built by the USA, Japan, Switzerland, and the EC, and joint experiments on superconducting coils will be conducted in the United States).

Plasma wall interaction plan. (The Tokamak-type TEXTOR being constructed in West Germany will be utilized to study interactions between the plasma and the vacuum container walls.)

Radiation damage to nuclear fusion material research plan. (The FMIT materials testing facility in the United States will be utilized, and neutron irradiation damage will be studied. Japan is expected to start participation next year.)

In addition to the Doublet III plan, Japanese-U.S. involvement includes the interchange of about 30 people each year to conduct cooperative research on plasma physics, and recently there has been a call from the United States for participation in the construction of FMIT. At the same time, there is a personnel exchange with the Soviet Union, although on a smaller scale compared to that with the United States.

In the midst of these active international efforts, the Nuclear Fusion Subsection of the Energy Research Inquiry Committee revamped the U.S. long-term plan for nuclear fusion research and development, saying: "In pursuit of future international cooperative efforts, any such effort with Japan will be profitable as far as we are concerned." In this manner, Japan was pointed out as a singular case, and this became a conversation piece among Japanese nuclear fusion researchers.

Why did this subsection raise Japan up to the level of an important partner? The reasons were not given, but Japanese people in the know think there are "three possible reasons."

1) The Japanese research team dispatched to the United States through the Japan-USA cooperative agreement used the Doublet III facility to come up with some world-shaking research results, following which the level of Japanese research was reassessed.

2) Unlike the United States, where the researchers hand-tool their apparatus, private industry in Japan has been engaged in the development of equipment and has provided a high level of industrial technology. This private industrial technological strength was evaluated and is expected to be exploited.

3) Japan is expected to provide capital.

These are the analyses. The expectations from Japan are increasing throughout the world, as evidenced by this example.

"There is merit in the fact that we can participate in funding on a mutual basis, but there may be need to consider future international cooperative efforts from the standpoint of balance in technology accumulation," according to the Science and Technology Agency.

Uneasiness in Domestic Accumulation

On the other hand, there are many voices which oppose putting so much effort into international cooperation. "At the present time, international cooperation related funds make up 10 percent of the total nuclear fusion research budget for Japan" (Science and Technology Agency). While not all the funds go overseas, a considerable amount of funds which normally would go to domestic industries are directed overseas, and there is a possibility that technological strength accumulation by Japanese industry is being dissipated.

Nuclear fusion is expected to become the most promising energy source for the 21st century. Former Prime Minister Fukuda was quoted as saying that whenever the occasion permits, "the vigorous promotion of nuclear fusion development will be a means to check the oil price strategy of OPEC (Organization of Petroleum Exporting Countries)" and this may not be far from the truth.

It may become possible to say that the effect of promoting nuclear fusion development in Japan has greatly exceeded the hopes of the researchers.

Situation at Japan's Research Organs on Various Nuclear Fusion Modes

(I) Nuclear Confinement		
Open-end systems		
--Mirror type	Tsukuba University	Gamma 6 Gamma 10 (under construction)
--Cusp type	JAERI	RFC-XX
(Closed end) torus type		
--Tokamak type	JAERI	JFT-2 JT-60 (under construction)
--Stellarator type	Nagoya University	JIPPT-II
--Heliotron type	Kyoto University	Heliotron D, E
--Stereo magnetic axes torus type	Tohoku University	Aspirator NP-3
--Bumpy torus type	Nagoya University	NBT
--Pinch type	Industrial Science and Technology Agency-Electrotechnical Laboratory	TPE-I TPE-II (under construction)
(II) Inertial Confinement		
--Laser explosive-contractive	Osaka University	Gekko IV, Rekko III Gekko XII (under construction)
--Particle beam explosive-contractive	Osaka University-Nagaoka Institute of Technology	Reiko IV Echigo

Major Nuclear Fusion Facilities in Foreign Countries

United States		
Mirror type	--Los Alamos Laboratory	TMX, FMTF
Tokamak type	--Princeton University Plasma Physics Laboratory	PLT, PDX, TFTR
	--Massachusetts Institute of Technology	Alcator
	--General Atomics Company	Doublet III
Laser type	--Lawrence Livermore Laboratory	Shiva

[Continued on following page]

United Kingdom		
Magnetic confinement	--Culham Laboratory	HBTX, CLEO, TOSCA SC-Levitron, DITE
France		
Tokamak type	--Fontenay-aux-Roses Laboratory	TFR
West Germany		
Magnetic confinement	--Garching Plasma Physics Laboratory	Pulsator, ISAR, W-VII A HBS, Belt Pinch, ASDEX
Theta pinch	--Julich Laboratory	TENQ
Soviet Union		
Tokamak type	--Kurchatov Laboratory	T10, T15
Mirror type	"	PR-7

2267
CSO: 4105

SCIENCE AND TECHNOLOGY

NEW INJECTION DEVICE RAISES ENGINE FUEL EFFICIENCY TEN PERCENT

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 pp 1, 15

[Text] Mikuni Corp., a Tokyo carburetor manufacturer, has developed an electronically-controlled fuel injection device which reportedly raises an engine's fuel efficiency by at least 10 per cent compared with conventional fuel-injection engines.

The secret lies in elimination of the time gap between the change of a car's running conditions — such as accelerating or braking — and the engine's adaptation to it, according to industry sources.

The leading auto parts maker, formally known as Mikuni Kogyo Co., already has sought patents in Japan and key Western nations for its new electronic fuel injection device incorporating a microprocessor.

Informed sources said that conventional electronic fuel injection devices, including a well known lines developed by Robert Bosch GmbH of West Germany, had a delay of 0.2-0.3 second before the engine adapts to the change in running speed. Such an injection device orders the engine to change functions after receiving information on the change in running speed through an electronic sensor and other means, they said. Such a fuel injection device spews a mixture of fuel and air into the engine combustion chamber, and replaces the conventional carburetor. The built-in sensor constantly monitors engine temperature, revolutions and other conditions and electronically controls the amount of fuel-air injections according to every change in information.

The sources said that Mikuni's fuel injection device will be commercialized within two years.

The company's tests of an experimental model mounted on a small car showed that it was at least 10 per cent more efficient than the best known conventional fuel injection device, the sources said.

Informed sources said conventional injection devices have been high priced — usually ¥70,000 to ¥80,000 a unit—, and moreover, have not necessarily been so efficient as to totally supersede the carburetor. Thus, no more than 21.5 per cent of all new domestically-produced cars registered in Japan in the second half of 1979 were equipped with such fuel injection devices.

The sources saw possibilities of such a stalemate in the dissemination of electronic injection devices in Japan's automobile production being broken by Mikuni's prospective commercial manufacture of its new device at a lower price through mass production as well as the apparently decided improvement in the efficiency of such injection devices it promises.

An expert of the Ministry of Transport's Traffic Safety and Nuisance Research Institute admitted theoretical feasibility in the corporation's believed achievement and expected an amazing set of hardware and software to result if it is refined into applicable form.

A spokesman of Nissan Motor Co., which, like Toyota Motor Co., has developed its own microprocessor-equipped electronic fuel injection device, said it is still too early to comment on Mikuni's new achievement, or to differentiate it from Robert Bosch's patented technology due to lack of detailed information.

He said every fuel injection device should have some time lag, adding that his company's equivalent device has experimentally attained 3/10,000th or 4/10,000th of a second in such a time gap, that is, almost zero.

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENTS IN AIRCRAFT INDUSTRY REPORTED

Continued Government Subsidy Asked

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 17 Dec 80 p 9

[Text] Transportation Equipment and Transportation: Aircraft Industry Asks For Continued Government Subsidy, Even After Completion of Aircraft, as It Prepares to Develop YXX

In conjunction with the start of the production of commercial aircrafts (YX=Boeing 767) for the coming period and with the development of the same (i.e., YXX) for the period after that, the aircraft industry has decided to request government subsidy for its aircraft production. At present, government subsidy to the industry is in the form of aid to develop "advanced technologies." Such aids, however, are terminated after the aircraft are completed, and the amount of investment needed for their production reaches a peak also after their completion. The industry and the corporations feel that it is too risky for them to handle such a difficult situation alone. For this reason, they have decided to ask that the existing situation be corrected. For the present, the industry will make a strong effort to request government subsidies to apply even after the completion of aircraft; in the future, however, they plan to study and appeal for such measures as interest subsidy programs which are available to the shipping industry.

Request to Include Interest Subsidy in the Future

In Japan, in addition to the three [major] aircraft manufactures of Mitsubishi Heavy Industries, Kawasaki Heavy Industries, and Fuji Heavy Industries, there are the Shin Meiwa Industry and the Nippon Aircraft, as well as the Ishikawajima Harima Heavy Industries which specializes in jet engines. The total annual sales of the aircraft manufacturers, excluding the jet engine manufacturing, is about 260 billion yen, distributed among the Defense Agency procurements of submarine detectors, F-1 jet fighters, and training crafts for beginners and advanced pilots, and among the various small craft and helicopters; it is a small industry.

The aircraft industry is entering a period of growth as it prepares to produce F-15 jet fighters and P-3C submarine detectors, which the Defense Agency will introduce for the first time, and the YX commercial aircraft. As a step toward rapid progress in the future, the industry has set its direction to develop and manufacture commercial aircraft as its major products as well as craft for the Defense Agency.

However, the development of commercial aircraft is a giant project costing 250 to 500 billion yen to develop a model. At present, there is no way for the aircraft industry to come up with such huge sums of development expenses.

The Ministry of International Trade and Industry is subsidizing the development of commercial aircraft under the name of advanced technology research, but this subsidy is terminated when the makers complete and deliver their aircraft. The current government subsidy program has created such side effects as cumulative deficit of 36 billion yen for the YS-11 and, in the case of YX, an unavoidable situation of subcontractor status in which the three manufacturers combined are responsible for as little as 15 percent of the production of the Boeing 767.

A serious search is now under way for a partner in the production of YXX. There is the view that the industry's desire to secure at least one-third of the production of the aircraft in Japan is in vain under the current system [of subsidy]. The industry feels that if government subsidy were to continue even after the delivery of the aircrafts, that will benefit not only [the production of] YXX but also the future development and production of aircraft bodies in general and, moreover, will have significant implications not only for the aircraft industry but also for the future of Japanese industries as a whole. Based on this view, the industry plans to appeal vigorously the introduction of a new system [of subsidy] to various authorities concerned. Furthermore, as a part of its future policy, the industry plans to appeal for the application of interest subsidy measures in the production of commercial aircraft.

9710

Company To Be Abolished in 1982

Tokyo NIHON KOGYO SHIMBUN in Japanese 18 Dec 80 p 1

[Article: "Japan Aircraft Manufacturing Co. to Be Abolished in 1982 - Law Repeatedly Revised in the Diet - New Society to Be Formed for the YXX's While Production of YS-11's to Go On"]

[Text] According to statements made public by official sources on 17 December, the Government has decided on the dissolution by the end of 1982 of the special government corporation Japan Aircraft Manufacturing Company (Hanzan Kaichiro, President, with a capital of 7.8 billion yen) which till now has been in charge of the development of the YS-11. This is a decision officially taken at the cabinet meeting of 29 November. This means the abolition of the regulations governing the Japan Aircraft Manufacturing Company and the abandonment of the repeated revisions made in the Diet with regard to the promotion law encouraging the aircraft industry which stipulates what should be the shape and functioning of said company. At the same time, together with the takeover of JAMCO's remaining functions there is a plan to include in the same law provisions for setting up a private investment

corporation as the main agency to develop the YXX, a civilian tourist class airplane, and for making that corporation into the nucleus for aircraft development in place of JAMCO. However, in the dissolution of JAMCO there is the need to get the full support of the Treasury in regard to the absorption of the employees and the cancellation of the deficit. It appears that at the 29 November Cabinet meeting which took the above decision there was a quite lively discussion around the Ministry of International Trade and Industry's functions in regard to the decision.

The Cabinet Decision of 29 November

JAMCO was formed in June 1959 based on the aircraft industry promotional law, at the present time the government shares come to 53.8 percent. It was JAMCO which came up with the blueprint for the YS-11 and which trial manufactured the first model but the actual production was delegated to Mitsubishi Heavy Industries and other manufacturers of airplane components. In 1973 182 YS-11 were being produced when production had to be cancelled.

Thereafter JAMCO picked up the responsibilities of after services of the 162 YS-11 that it put into operation and performed such functions as (1) product support (supply of parts), (2) technical assistance services, and (3) claims collection on the deferred payment for the aircraft. The annual proceeds come to about 1.5 billion yen.

However, by the end of 1978 the accumulated deficit came to 7.52 billion yen and faced with the prospect of its climbing to 8.4 billion by the end of 1981 it became a pending question for JAMCO as to how to take care of it.

As far as the government is concerned, this is also part of its administrative reforms. Since it is resigned to the course of dissolution of JAMCO by the end of 1982, to carry it out it has firmed up plans (1) to wipe out entirely the deficit by reducing the capital investment money by 100 percent while at the same time subsidizing to the tune of 3 billion yen (.6 billion in 1981) and (2) to absorb 120 of JAMCO's employees in various civilian aircraft manufacturing companies, especially Mitsubishi Heavy Industries, Kawasaki Heavy Industries, and Fuji Heavy Industries. It has also started to negotiate for all related aspects of the problem.

The government has also decided to set up a new body responsible for the development of the YXX after the dissolution of JAMCO. Thus, together with the complete doing away of the repeated revisions of the aircraft industry promotion law by the Diet and of the stipulations governing JAMCO, it has been clearly stated in the same law that there would be a new society formed. This new society would take the form of either a licensed company or a foundation and it would be formed not by government shares but by capital put up by the various civilian companies that have to do with the manufacture of aircraft. And this new society would inherit such functions from the remaining functions of JAMCO as (1) the takeover of development and manufacturing responsibilities while it would (2) commission such functions as the product support of the YS-11's to the various body and repair companies.

Furthermore, there are plans also for this civilian transport aircraft development society, which will be responsible for the development of the YX (next in line as the civilian tourist class plane), to complete its basic setup by the middle of 1982 while it would work on the promotional model of the YXX by pushing the collective designing which is being done right now with the Dutch company Fokker and the U.S. Boeing company.

1751
CSO: 4105

SCIENCE AND TECHNOLOGY

NEW SUPER BULLET TRAIN TO BE DEVELOPED BY JNR

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 11

[Text] The Japanese National Railways has started to study plans for a "super bullet train" running the Tokaido-Sanyo Shinkansen lines. It could save both energy and time, officials disclosed recently.

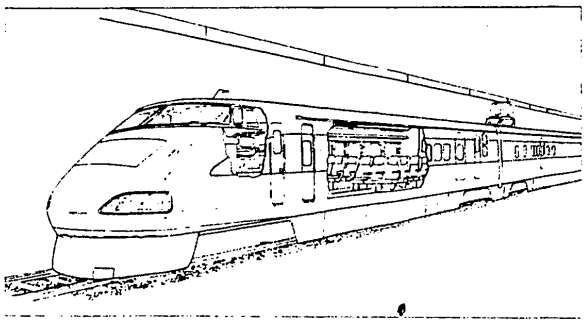
JNR officials said the new bullet train is designed mainly for greater speed and will be much smaller and lighter than the present trains. It will be introduced into operation in the late 1980s if things go smoothly.

The JNR has been working to remodel the present bullet train and come up with this new faster, energy-saving "super" train to compete with airplanes over long distances. It also plans to build two-deck bullet trains to accommodate more passengers and wider seats.

Officials explained that the concept of "super bullet train" was born out of their awareness that they must do something to cope with the new faster trains developed by France and Britain. The French National Railways plans to run the new super express train "TGV" between Paris and Lyons at a maximum speed of 260 kilometers per hour and the British National Railways also has plans to run another super express "APT" between London and Glasgow at a maximum speed of 250 kilometers per hour. Both "TGV" and "APT" trains are 2.8 meters wide and run on the standard gauge of 1.435 meters.

The new "super bullet train" to be developed by the JNR will be, officials said, 2.98 meters wide (compared with the present 3.38 meters), 3.68 meters high (3.98 meters) and one train will weigh about 48 tons, 8 tons or 15 per cent lighter than the present train, using aluminum and other light non-ferrous metals instead of present steel sheets. And the train will be made into a cylindrical type to lessen the air resistance for greater speed. As a result of all this, the "super bullet train" will have a maximum speed of 260 kilometers per hour instead of the present 210 kilometers and could run the line between Tokyo and Shin-Osaka in two and a half hours, between Tokyo and Hiroshima in 4 hours and between Tokyo and Hakata in five and a half hours to be competitive with planes.

On the other hand, the much lighter and smaller trains will lessen the energy needed to run. The present bullet train consumes about 20,000 kilowatts or costs about ¥300,000 if it runs once between Tokyo and Shin-Osaka, but the super bullet train will consume 10-to-15 per cent less power than the present one in a run between Tokyo and Shin-Osaka.



'Super bullet train' designed to cruise at 260 km/h

CSO: 4120

SCIENCE AND TECHNOLOGY

ENERGY EFFICIENT SHIPS SAID GOAL OF SHIPBUILDING INDUSTRY

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 18, 19, 20 Feb 81

[18 Feb 81, p 9]

[Text] Bunker oil which cost barely $20 per kilo prior to the oil shock shot up about $100 in a short time, and has risen more than 10 times to exceed $220. It accounts for more than 50 percent of total sea transportation costs. The situation has resulted in fierce competition over ship fuel economy. Fuel efficiency has now become the prime sales point concerning the shipping world. Engine manufacturers and shipbuilders have joined maritime transport companies in various efforts toward that objective and are showing results. In the effort to recover from the recession in shipbuilding circles, fuel efficiency is becoming the focal point in the pursuit of added values. We will therefore attempt to analyze present conditions in three categories. They are 1 fuel efficiency for main ship engines, 2 fuel economy concerning propulsion plants and 3 energy savings based on ship configurations.

The four manufacturers of low-speed diesel engines are Sulzer of Switzerland, B&W Diesel of Denmark, M.A.N. Ltd of West Germany and Mitsubishi Heavy Industries of Japan. They are not only in fierce competition with each other, but also within their respective enterprise groups, including Japan's top shipbuilders who are their licensees.

B&W was the first company to embark on the energy efficiency drive. In 1977, it developed the "twin tank engine" (two engines mounted on one base) jointly with its licensee, Hitachi Shipbuilding. It switched from the previous dynamic pressure supercharge formula (which sends the exhaust gas directly to the supercharger) to the static pressure supercharge formula (which first collects the exhaust gas and then keeps it at constant pressure), and thereby achieved substantial energy savings. Subsequently, Mitsui Shipbuilding perfected the static pressure supercharge "GFC series" and succeeded in reducing the consumption rate to below 140 grams (engine cylinder diameter: 90 mm) per 1 hp/hr for the first time. At this time, the Sulzer Company and the M.A.N. Company, who were known for their "loop scavenging" formula, also adopted the static pressure supercharge formula. B&W was the only company using the "uniflow" formula. Thus the merits of the static pressure supercharge formula were evident at their peak.

In the spring of 1980, B&W announced its "GFCA series" with a boost in power by 15 percent, and introduced the concept of the optimum energy-efficient operation

called"delating." This changes the engine output plan to a partial-load operation and, under the average effective output selected according to the engine plan, the maximum pressure inside the cylinder is adjusted to the pressure at a set continuous quantum HP/hr, in order to lower energy consumption. Hitachi completed the engine to record a consumption rate of 134 grams. B&W reduced the consumption rate to 131 grams, and subsequently received a flurry of orders.

The Sulzer Company, which had always been in the forefront, met the challenge in June 1980 with its "RLA series," which has an enlarged diameter plunger for its fuel pump and an improved injection nozzle. In addition, by designating the VIT (injection period adjuster), developed by a licensee, as its standard equipment, the company lowered consumption to 137 grams. Subsequently, in September, Sulzer too decided to adopt the "delating" formula, incorporated the RLA series into the RLB series and announced that it had four optional methods for the use of the same type of engine. It thus lowered the consumption rate to 132 grams and, although it lagged behind B&W, it made diligent progress in its technical development.

Meanwhile, the West German M.A.N. Company and Japan's Mitsubishi Heavy Industries both attained the level of 130 grams--the former by putting the electronic control fuel injector into practical use and adopting the "delating" formula; the latter by successive technical improvements.

However, the competition between B&W and Sulzer goes on. B&W plans to announce the "GFCB series" in the middle of this year, with 126 grams as its reported target. On the other hand, Sulzer announced that it will lower the present guaranteed figure for its "RLB series" by another 3 grams, beginning in the delivery period in the last half of 1982, and it has confirmed this in an RLB simulated test using the RLA.

The recent tendency to guarantee energy savings could be somewhat presumptious. Among the engines actually installed on ships, no company has attained a consumption rate below 130 grams. However, at the present rate of progress, it is bound to turn into a race at the 120s [grams] level.

Meanwhile, there is intensifying competition to cut energy costs for the medium-speed diesel engine, which has lagged behind the low-speed engine. The Semuto [phonetic] Company of France, in its "10PC4V model," adopted the new MPC exhaust pipe formula, which combines the merits of both the dynamic pressure and static pressure types, has an improved fuel injection rate, brings the timing of the air supply and exhaust valves to an optimum level, and uses the high efficiency supercharger. It thus reduced energy consumption to the 131 gram level. Nippon Kokan and Ishikawajima-Harima Heavy Industries are also making similar efforts, and their PC engine will soon adopt the "delating" formula.

Also, among the M.A.N. Company's medium-speed engines, an optimum modified version of the "18V52/55A fuel injection engine was built and successfully tested at the 129 gram level by Mitsubishi Heavy Industries. Medium-speed engines have thus actually reached the level of low-speed engines.

As long as the price of bunker oil continues to rise, the competition over a margin of 1 gram in energy efficiency for diesel ship engines will not abate.

Usually, shipowners and engine makers (shipbuilders in the case of Japan) have a strong bond of mutual trust, and a slight difference in energy costs reportedly never becomes an issue.

Cumulative Production by Hitachi & B&W--9 Million HP

On 17 (Feb), Hitachi Shipbuilding (Masao Kinoshita, president) completed the Hitachi-B&W 6L90GFCA model engine (19,900 HP) to be equipped on the bulk carrier (122,500 weight tons) of the Yamashita Shin Nippon Steamship Line, and it announced that the cumulative production of the Hitachi-B&W model diesel engine had topped 9 million HP.

Since forming a joint venture with the B&W Diesel Company of Denmark in 1950 to produce and sell the B&W diesel engine, the cumulative production has reached 2,098 units with a total capacity of 9,018,205 HP. Hitachi also joined in technical cooperation with the Sulzer Company of Switzerland to produce the Hitachi-Sulzer model diesel engine (cumulative production of 170 units for a total capacity of 2,167,780 HP). The combined total production of the diesel engines would exceed 11 million HP.

Since last year, a low-energy consuming version of the B&W model main engine at 130 grams per HP/hr has been under development, and it is leading its competitors, Sulzer and M.A.N., by a wide margin. The company is also currently developing a new model (6L90GFCB), the world's first 120-gram level engine, amidst great expectations.

[19 Feb 81, p 11]

[Text] How much of the high-temperature, high-pressure gas energy emitted from a main engine can be recovered and recycled? This is another major question being pursued concerning energy efficient ships. The ship is treated as a plant and the aim is to set up a comprehensive low-energy cost system. It is a concept especially aimed toward minimizing the use of A-grade crude oil. The leading shipbuilders are making full efforts toward developing their own efficient and economic plants.

The concept of using an exhaust gas economizer for ship heating was advanced soon after the war. It began 20 years ago by turning on the exhaust gas turbo electric power generator to supply the necessary power. Of course, it was an era when bunker oil was being used quite extravagantly and merely fulfilling the needs sufficed. However, a new direction toward stricter energy use became necessary with the eruption of the oil crisis.

In September 1980, Mitsubishi Heavy Industries announced the development of the epochal "D-MAP Mark II" system at the meeting of the Shipbuilding Engineering Society in the United States. The company was the first in Japan to work on exhaust gas turbo electric generation, and with the Mark II it improved the recovery rate for exhaust gas energy and also added a new element to the process. The high pressure steam discharged from the exhaust gas economizer not only catches electricity via the turbo electric generator, but it also helps to operate the main engine by being recycled to the main axis by means of an auxiliary turbo. Furthermore, the low

pressure steam catches the residual electricity from ship heating and carries it to both the turbo electric generator and the auxiliary turbo. This innovation has amazed the world's shipbuilders.

As exemplified by the 130,000 weight ton bulk carrier, the turbo generator generates 700 kilowatts and the auxiliary turbo generates 300 kilowatts, totalling 1,000 kilowatts of electric power. Incidentally, the normal power needs for ships are 500 kilowatts during the winter and 550 kilowatts during the summer, with half of the power returned to the main axis to increase propulsion. Thus, an energy savings of 20-30 percent above that of the conventional energy efficient plant became feasible. If this power were generated by a diesel auxiliary engine, the use of a considerable amount of A-grade crude oil (1.6-1.7 times C-grade oil) would be necessary. Today, the diesel auxiliary engine is used merely for cargo handling purposes.

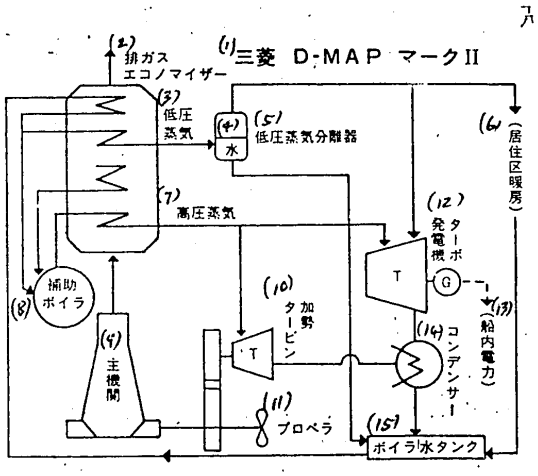
The Mark II can be used on both low-speed and medium-speed diesel engines, and today its exhaust gas is used at low speed with a temperature range of 300-128 degrees Centigrade, and at medium speed with a range of 350-122 degrees Centigrade. However, an opinion is expressed that, even then, "there would still be more than a 50 percent waste of exhaust gas energy. We hope to take another step forward in recovering this waste." (Seiichi Ishikawa, ship engineering division, Mitsubishi Shipbuilding Corp)

Ishikawajima-Harima Heavy Industries followed with the successful development of a number of new energy efficient plants. In October of last year, it connected the main engine directly to the turbo generator to develop the "SSG system," which is able to control the electricity at will, regardless of the surplus or shortage in power. It thus overcame the weaknesses of the exhaust gas turbo generator under low main engine output or during slowdown operations. In addition to supplementing the output shortage from the turbo generator with power from the main engine, it returns surplus output from the exhaust gas generator to the main engine to be used for propulsion. This results in a 30 percent energy saving, and the additional investment reportedly could be recovered in 2 or 3 years.

This year, Ishikawajima-Harima Heavy Industries also developed Japan's first electric power generating system carrying a main axis, which is the best system for power-consuming refrigerator ships. An alternating current (AC) generator is placed on an axis between a low-speed D engine and the propellor, and it has become commercially feasible. Its special characteristic is its ability to operate parallel and consecutively with an auxiliary diesel engine operated generator and an exhaust gas turbo generator. A trial balance shows that it saves 1,500 tons of A-grade oil annually by using C-grade oil. Another important point is its ability to stabilize the output frequency and electric power pressure, which change during operations, by using an out stabilizer.

Meanwhile, Nippon Kokan also recently developed a new type of energy efficient plant for its cargo ships carrying steel refining materials. It is a combination of an exhaust gas turbo generator, a main axis generator plus motor (SGM) system and a large-guage variable pitch propellor. The daily fuel consumption of a 140,000 weight ton ore ship is 47 tons, which is a 40 percent saving compared to previous plants, and it saves 60 percent under slowdown operations at 12.5 knots.

Other major shipbuilders also have energy efficient plants using exhaust gas turbo generators, and they are making efforts to improve the recovery rate of exhaust gas energy. The technical competition is at a point where oil is squeezed even from "cleaning rags."



Keys:

(1) Mitsubishi D-MAP Mark II
(2) Exhaust gas economizer
(3) Low pressure steam
(4) Water
(5) Low pressure steam separator
(6) Heating for living quarters
(7) High pressure steam
(8) Auxiliary boiler
(9) Main engine
(10) Support (auxiliary) turbine
(11) Propellor
(12) Turbo electric power generator
(13) Electric power for use inside ship
(14) Condenser
(15) Boiler water tank

[20 Feb 81, p 9]

[Text] A ship able to increase its speed at a set power output is considered to be efficient. However, under the recent slowdown operation drive, it is considered adequate to use lower power output, if, conversely, the efficiency rate can be improved at a set speed, requiring that much less fuel consumption. To enhance such an efficiency rate, the various shipbuilders are using every means to conserve energy, such as economizing as much as possible on paints for the ship stern and bottom. When paint costs are paid by the cargo owner, pressures for cost-cutting become increasingly severe.

Of the ship's hull features, the configuration of the stern is most crucial. It is important to arrange the flow of the sea water into the propellor in order to increase the propulsion force. In December 1979, Mitsui Shipbuilding won the cooperation of Exxon, the largest oil major, and succeeded in commercially developing the "MIDP" duct propellor for Mitsui vessels. It has a drill-shaped duct in front of the propellor, which has a spiral wrapped inside it to rectify the water flow and reuuce the hull resistance. Also, the duct itself generates thrust which enhances the propulsion efficiency rate. The larger the ship, the greater the fuel economy, which varies according to the ship's speed and cargo load, but the economy was 5-12 percent in the case of the VLCC and ULCC.

Exxon-owned ships were the target at the outset, but the scope was enlarged to include North European, Hong Kong and domestic vessels, and the orders received thus far include 68 operating ships (of which 44 have been equipped) and 22 newly built ships (of which 2 have been equipped). Among these, tankers are of course the most numerous with 67, followed by 15 bulk carriers. The output of the main engines ranges from 13,100 to 45,000 HP.

A simulated test of the MIDP is conducted in a water tank to design an optimum duct system. The average construction cost is 100 million yen, and 4-5 MIDPs are produced per month.

There is also the "HZ nozzle" designed by Hitachi Shipbuilding to rectify the water flow toward the propellor. In this case, a cone-shaped nozzle is placed in front of the propellor and it tapers down toward the ship's bottom. According to trial balance from the test results, an annual savings of about 1,150 tons of fuel is possible on a 130,000 ton ship. It is equipped on 60,000 ton and 130,000 ton bulk carriers and 80,000 ton tankers now under construction, and the first unit was completed in August last year.

On the other hand, the "reaction fin" adopted by Mitsubishi Heavy Industries is an example of the formula whereby gyration is applied to the water flow entering the propellor and the loss is minimized. Ordinarily, the sea flow (revolving current) occurs in the ship's wake in the same direction as the propellor revolution. However, the revolving current does not provide thrust for the ship, but is discharged as wasted energy, resulting in an energy loss of about 10 percent. To prevent this, a fin blade, which actually consists of 6 steel wings joined radially in a circular form, is attached in front of the propellor. By turning it in a direction reverse to the propellor revolution, it converts energy from the revolving current into propulsion energy.

A performance test on a 115,000 ton bulk carrier proved that an annual saving of 5-6 percent, or 40-50 million yen worth of fuel, was feasible. The impact is greater in proportion to the size of the ship, and it is also necessary to adjust the design according to each ship. There are presently some 10 inquiries submitted, mainly for reconstruction. The reaction fin not only conserves energy directly, but has also brought secondary benefits in the form of reduced ship vibration and lower cabin noise levels, and Hitachi is conducting research in his area.

Also, Kawasaki Heavy Industries has actually installed the "KHISEB" stern bulb on a ship. It is a bulb-like device attached to the stern near the loadline and was

put into practical use under the guidance of Takao Inui, professor emeritus of Tokyo University. Wave resistance is decreased by the interaction between waves produced by the bulb and waves coming from the ship stern, resulting in increased thrust. It is predicted that it will save some 70 million yen annually for car ferries and container ships.

Such energy saving devices for ship sterns are actually having a considerable impact, but there are large disparities in the economy figures announced by the various enterprises. Of course, they are closely related to the overall designs of the ships. Therefore, a simplistic comparison is not feasible. The hull configuration constitutes the basis for any energy economy, and each shipbuilder is repeating the trial and error process in water tank tests with the use of computers. The ideal ship configuration remains their perennial target.

Additionally, the quality of paint on the ship bottom has a large impact, because clam shells cling to the bottom and greatly reduce propulsion. A new paint containing organic tin was produced to counter this. The Nippon Paint Company developed the "SPC," while the Chugoku Paint Company developed the "Sea Flow" product. A great difference from previous paints is that, with the passing of time, the oxidized paint changes and becomes smoother. Since the paint problem involves a difference of 1 knot in speed within a year's time if left unsolved, a wide spread drive for fuel economy in this area is expected.

5884
CSO: 4105

SCIENCE AND TECHNOLOGY

MITSUBISHI STARTS USING 3 KILOWATT CARBON DIOXIDE LASER DEVICE

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 13

[Text]

Mitsubishi Heavy Industries, Ltd. (MHI) has begun using for its research a carbon dioxide gas laser of 3 kilowatts in output.

This is by far the largest metal processing laser of the kind industrially used in Japan, and possibly even in the world.

MHI said its new laser unit, specially produced by Mitsubishi Electric Corp., is installed at its Hiroshima Technical Institute at Hiroshima.

It is intended for developing a new kind of technology to process large parts of machinery, including those of aircraft, nuclear energy, steelmaking and industrial machinery. Such machine parts to be processed include big gears, shafts, and pipings.

As for foreign industrial applications of the CO2 gas laser, General Motors Corp. and Ford Motor Co. of the U.S. are said to have introduced such lasers of 2 kilowatts in output into their production lines. But just how their lasers have actually worked is still kept as their business secrets.

Outside industrial application, Japan now has a stronger CO2 gas laser device of 15 kilowatts, produced by Avco Corp. of the U.S. and installed at Osaka University's metallurgical research institute, but it is a scientific research type.

MHI's new laser is capable of cutting through steel plates up to 12 millimeters thick, welding any two pieces of steel up to 6 millimeters thick, each, annealing steel plates down to 2 millimeters deep, and regulating its output between 0.5 and 3.5 kilowatts.

MHI has found the CO2 gas laser best fit for large machinery parts for its high efficiency and low cost. Similar laser units of 1 to 1.5 kilowatts in output have so far been used experimentally by some Japanese automobile or other makers. But such units have been still limited in capacity and applicability. Now commonly industrialized in Japan are low output solid ruby and YAG types to do such cutting, welding and annealing jobs on only little metal goods.

CSO: 4120

SCIENCE AND TECHNOLOGY

POWER MICROSCOPE DETECTS METAL SCRATCHES

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 13

[Text]

An electron microscope that spots even minor scratches or damage on metal surfaces has been developed by a Japanese government institute in Hiroshima.

Low-energy electron emissions from the damaged parts are picked up by the microscope and displayed on a screen.

According to the Government Industrial Research Institute, Chugoku, of the Agency of Industrial Science and Technology, the Ministry of International Trade and Industry, detecting damage on metal surfaces of electron microscopy had been a hot subject of research in many countries. It consists in analyzing faint emissions of 0.1 to 0.5 electron volts known as the "exoelectron emissions."

The best conventional method had been "scanning" to excite those emissions by bombarding the surface with ultraviolet rays. The institute found the method limited in the precision with which the ultraviolet rays were concentrated on each point of scanning, locating the spot and regulating the speed of scanning, thus enhancing the most important resolution capacity.

The institute thus has developed its own "image-forming" method of hitting the entire surface of specimen with ultraviolet rays and then magnifying the whole image. It has also devised mechanical processes for determining the ...ent of fatigue, tensility, abrasion and other conditions and better positioning points of observation. Otherwise, the new method is the same as the conventional one, including the use of a vacuum chamber, as well as ultraviolet rays.

Since the electron microscope provides over magnification of 100 to 3,000 times, lesser enlargement of several to scores of times has also been made possible by adapting the advantages of the scanning type.

CSO: 4120

SCIENCE AND TECHNOLOGY

LOW-COST DIRECT REDUCTION STEEL TECHNOLOGY PROVES GOOD IN DEMONSTRATION

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 13

[Text]

A new low-cost direct reduction steelmaking process jointly developed by Sumitomo Heavy Industries, Ltd. and Lummus Co. of the U.S., has proved to work very well in a series of demonstration tests.

The method is unprecedented in that it uses very cheap oil refining residues as both the fuel and the reducing agent.

According to the Japanese company, the basic direct reduction method of making steel is well known for reducing iron ore and producing pig iron in pelletized form, in contrast to the conventional blast furnace method to melt iron ore and extract pig iron.

The new process could clearly supersede the shaft furnace process among numerous known processes of direct reduction steelmaking because it is a decided departure from the shaft process in that it needs neither the expensive oxidized iron pellets nor natural gas as does the shaft process. Natural gas is available at a low cost only in limited producing areas, but the new process is free from such a geographical limitation.

The new process consists in burning pelletized iron ore and the oil refining residues in a rotary kiln to obtain immediately pig iron of very low sulfur content, averaging only 0.03 per cent or less.

It also promises production of salable by-products, like naphtha, kerosene and light oil running out of the kiln, and an effective answer to the environmental problem of how to treat such highly sulfurous oil refinery residues.

Sumitomo plans to sell the new process to Japanese steelmakers by plugging its immediate advantage of cost reduction, and its indirect benefit of filling the growing short supply of scrap iron and steel.

CSO: 4120

SCIENCE AND TECHNOLOGY

PHOTOMULTIPLIER TUBE WITH BIGGEST DIAMETER PRODUCED

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 13

[Text] A new photomultiplier tube, a photoelectric tube to detect light in the form of electric current, having the world's largest caliber of over 50 centimeters, has been developed.

According to the Ministry of Education, the new tube is the brainchild of the Ministry's National Laboratory for High Energy Physics at Tsukuba City, the University of Tokyo, and Hamamatsu TV Co. at Hamamatsu.

Intended for determining the life span of protons, it is code-named "HTV-R1449X." It measures 50.8 centimeters in diameter and 56 cm in length, and is equipped with 13 dinodes. (Dinodes are secondary electron emitters that multiply electrons emitted by the light energy emerging from protons.)

The new tube has proved to be 16 times as strong as conventional tubes in light-collecting capacity, and four times as large in energy resolution capacity to differentiate the light-emitting sources by energy level.

Its rate of multiplication of the original light-turned-electron energy has attained 10 million times.

Various disadvantages of such a large caliber tube, such as noises and a longer time required for light-to-electron energy conversion, have been minimized. That time has been reduced to about 8 nanoseconds.

The new device is to be used for an experimentation on integration of protons as planned by a joint research group between the laboratory and the university. According to the group's elementary particle theory, protons, instead of being unlimited in life span as hitherto presumed, seem to have a certain length of life.

By exactly measuring that life span and making a complex kind of reverse calculations, the group plans to establish its "grand unified theory" to explain three forces believed to be at work in nature — electromagnetic interactions, weak interactions, and strong interactions.

The new multiplier is still a test type. If it works well, a full-scale model is expected to be produced by Hamamatsu TV in quantity from the end of this year.

A photomultiplier has a number of dinodes, made of some metallic compound including antimonium and cesium, between its cathode and anode. Light received by the multiplier is discharged in the form of electrons from the cathode toward the anode. Each dinode, when hit by the electrons, emits two to three secondary electrons. Many dinodes do such emissions in succession to multiply the electron energy to make the originally feeble light and its electron equivalent detectable. The conventional photomultipliers had been limited to 10 to 15 centimeters in caliber with corresponding small light collecting capacity.

The group has presumed the proton life span at approximately 1,000,000 billion times of 1,000,000 billion years (10 raised to 30 or 32 power). To measure that life span precisely will require keeping about 2,700 tons of pure water (in scientific terms) in a huge square tank measuring 14 meters wide and high, and counting the annual rate of disintegration of protons in the water's hydrogen contents. The rate will be anywhere between 6 and 600 protons a year. A probability method of calculation is applied to obtain the answer.

Protons disingrate into positrons and pi-mesons, and the two latter also immediately disintegrate, in turn, into gamma rays. In such processes, protons emit a feeble bluish-white light due to a phenomenon known as the Cerenkov effect. To catch that light, 1,776 photomultiplier tubes will have to be attached around the tank. To avoid the effect of cosmic rays, such a tank must be built 1,000 meters deep underground, possibly in an unused mine shaft.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW ENGINEERING CERAMICS RESIST TEMPERATURE OVER 1,200 DEGREES

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 13

[Text] Two samples of modern, heat-resistant ceramics for machinery, such as aerospace and automobile engines, have been tested to withstand temperatures of over 1,200° C. (2,192° F.) and to be two to three times as hard as the best conventional equivalent, it was learned recently. The ceramics, recently developed by a government laboratory and a national university in Japan, may supersede metals and alloys in many engines.

The methods of producing the two samples are said to be without precedent anywhere. One sample was developed by the National Institute for Research in Inorganic Materials (at Sakura Village, Niihari Country, Ibaraki Prefecture) of the Science and Technology Agency.

According to the institute, its sample represents its unique "gas-pressure" method of baking the ceramic materials with baking aid materials in a nitrogen gas-filled furnace. The baking aids work by becoming glassy and bonding the ceramic materials together during the heating production process. But they dissolve into the final ceramic product without showing up on the surface.

The very absorption of the baking aids into the substance of the product solved a technological problem.

Previously such baking aids, usually magnesium oxide and yittrium oxide, are pushed out in the cooling process and remain as glassy impurities among the surface particles of the ceramic, weakening it under high temperatures. The institute used aluminum nitride and yittrium oxide as the baking assistants.

The other sample is from the Institute of Scientific and Industrial Research of Osaka University. According to the institute, its "solid compression" method needs no assisting material, but requires application of a tremendously high pressure of 10,000 atmospheres to silicic-nitrous ceramic material to mold it into the desired ceramic product. According to the institute director, the gas-pressure method is suitable for producing complex shapes, while his institute's method, for its freedom from impurities, is useful for basic research on the strength and other characteristics of new ceramics.

According to the two institutes, their products proved able to withstand 1,200 to 1,300 degrees C. of heat and two to three times as hard as the best conventional sample.

If a gas turbine engine made of heat-resistant ceramic becomes available, gasoline consumption on such engines could be halved because the engine could be operated at levels of high heat and high efficiency that are now impossible. Metals and alloys are limited to several hundred degrees in heat resistance.

Research and development efforts concerning such ceramics are said to be more advanced in Western countries than in Japan, but such methods are said to be unprecedented.

The Japanese Government has been subsidizing the two institutes' research as part of its hunt for new revolutionary industrial materials.

CSO: 4120

SCIENCE AND TECHNOLOGY

BRIEFS

INTERFERON CAPACITY RAISED--The Green Cross Corp. has raised its interferon production from 300 million to 1 billion units a month, making it a leading producer anywhere in the world. The drug company's central research laboratory in Osaka is producing interferon, with the output offered to an interferon team of the Ministry of Health & Welfare for clinical trials. The company intends to seek the ministry's commercialization approval as early as March for its interferon effective against eye infections. Green Cross produces it from blood's white cells. For cancer treatment, 200-300 million units are required per patient. But only several million units are needed to treat patients of eye diseases. The capacity increase was accompanied by blood imports from Green Cross's subsidiary, Alpha Therapeutic Corp of California. [Text] [Tokyo JAPAN ECONOMIC JOURNAL in English 10 Mar 81 p 12]

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